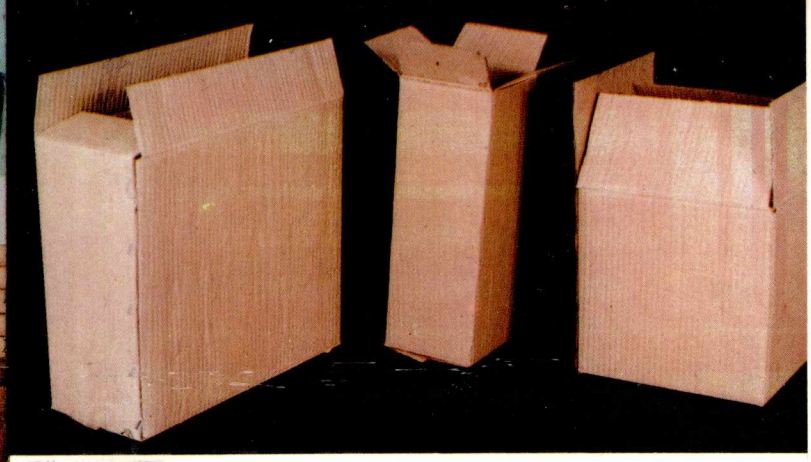

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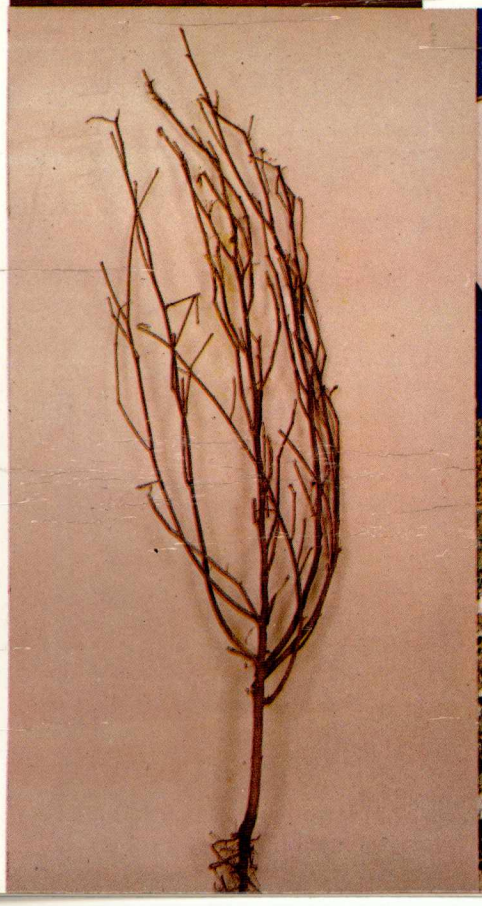
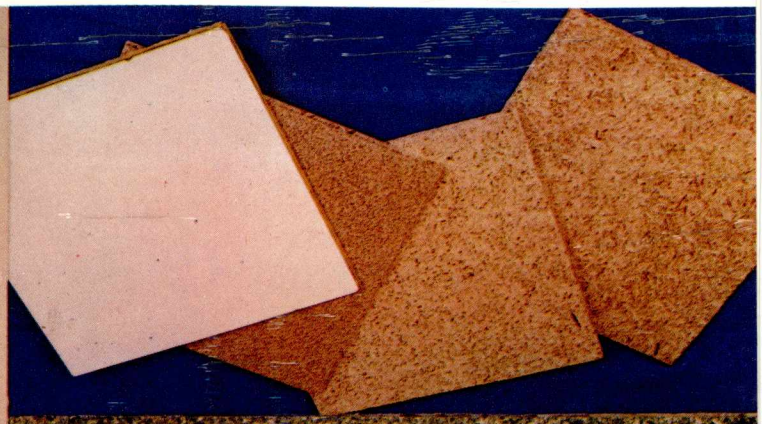
ICAR

Cotton Technological Research Laboratory

BOMBAY

Annual Report 1989-90





Cotton Technological Research Laboratory

Indian Council of Agricultural Research

Annual Report

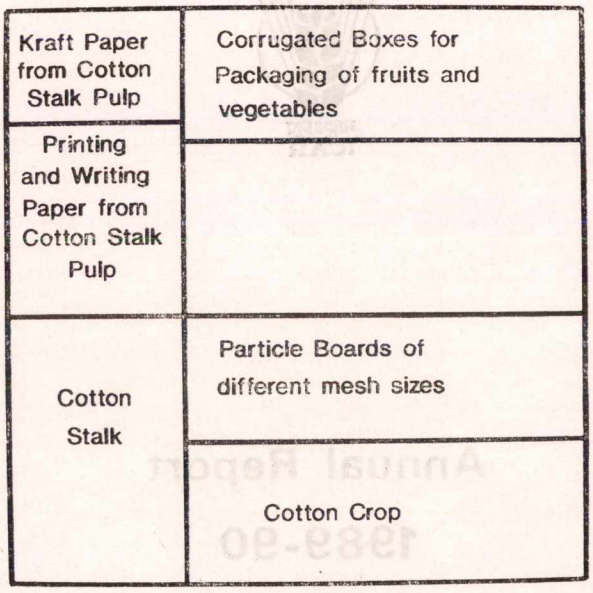
1989-90

BOMBAY

Front Cover Theme : "We want a stream of wealth pouring out from our fields, factories and workshops and reaching our country's millions, so that ultimately we may be able to see our dreams for India fulfilled"

— Pandit Jawaharlal Nehru

Front Cover Scheme :



Back Cover : Blow-up of the Surface of Particle Board Prepared from Cotton Plant Stalk Chips

Published by : **Dr. N. B. Patil**, M.Sc., Ph.D.
Director, CTRL, Bombay.

Edited and compiled by : **Shri T. K. M. Das** and **Shri M. Mohan**

Cover Design and Layout : **Shri T. K. M. Das**

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1

Introduction

This sixty-sixth Annual Report of Cotton Technological Research Laboratory (CTRL) covers the period, January 1, 1989 to March 31, 1990.

CTRL was established in the year 1924 under the name *Technological Laboratory* by the Indian Central Cotton Committee (ICCC). The objectives then were to undertake spinning tests on various strains of cotton received from agricultural departments in the country and to test cotton for fibre properties and relate them with their spinning values. To carry out these activities the Laboratory had established co-ordination with the Departments of Agriculture and Agricultural Universities located in major cotton producing tracts in India. All the commodity committees including the ICCC were abolished in 1966 and the Indian Council of Agricultural Research (ICAR) took over the administrative control of the Laboratory. Since then, the research activities of the Laboratory were reoriented and intensified to meet the challenges in respect of production and quality of cottons grown in the country. Side by side, research efforts are also directed towards better utilisation of cotton by-products, profitable use of cotton plant and their wastes, etc. so as to make cotton cultivation more remunerative in terms of providing new and increased avenues for rural self employment.

The important *Functions* of *CTRL* are listed below :

1. To participate actively in the programmes for improvement in the production and quality of cotton in India, by evaluating the quality of new strains evolved by agricultural scientists and giving them necessary technical guidance.

2. To carry out research on physical, structural and chemical properties of cotton in relation to quality and processing performance.

3. To carry out research investigations on the ginning problems of cotton.

4. To investigate the greater and better utilisation of cotton, cotton wastes, linters, cotton seeds, etc.

5. To help the trade and industry by providing reliable and accurate data on quality of representative trade varieties of Indian cottons.

6. To issue authoritative reports on the samples received for tests from Government departments, the trade and other bodies.

7. To collect and disseminate technical information on cotton.

Organisation : As could be seen from the organisational chart in Annexure I, the Director is the head of the laboratory, assisted by a team of senior and junior scientists. An Administrative Officer and an Assistant Administrative Officer provide him assistance in the general administration, while Finance and Accounts Officer looks after matters concerning accounts and audit of the Laboratory.

Library : An up-to-date library with books on cotton, cotton technology and allied subjects are maintained at CTRL. During the reporting period, the total number of books was 4212 with the addition of 178 books during this period. Similarly, the number of bound volumes added to the library was 150 making its total number to 5323. Out of 200 journals received dealing with textiles and allied subjects, 87 journals were through subscription while the rest were received on complimentary/exchange basis. The journals subscribed included 52 foreign and 35 Indian journals. The total expenditure for the library for 1989-90 was Rs. 2,36,655. Besides the staff of the laboratory, the library facilities were availed of by students and research workers from various institutions affiliated to the University of Bombay as well as sister institutions. Inter-library loan facilities were also available to other libraries in Bombay.

New Equipments : The names of major equipments acquired from January 1, 1989 to March 31, 1990 are given in Annexure II.

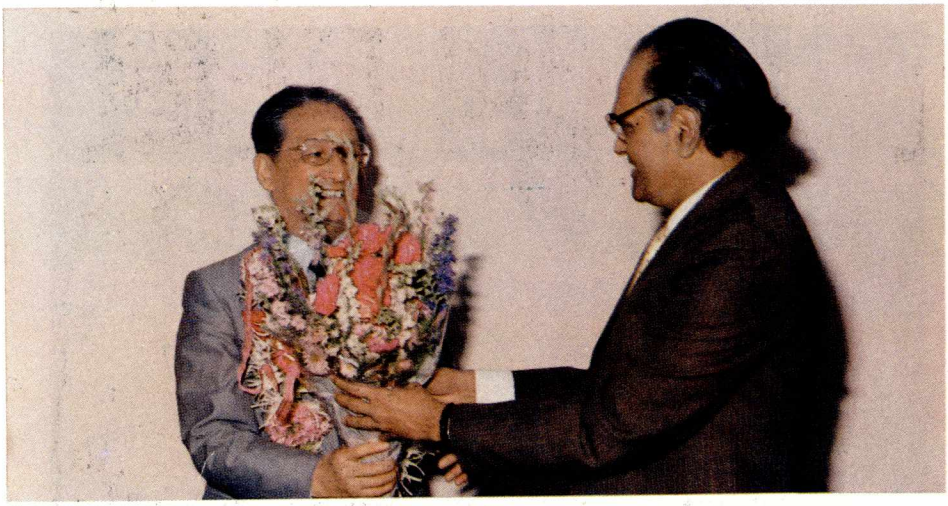
Distinguished Visitors : A Chinese Delegation led by His Excellency Mr. He Kang, Minister of Agriculture, China with Mr. Wang Ganhang, Director, Department of Agriculture, China, Hainan Province; Mr. Bai Zhenghuan, Director, Division of Asia and Africa of Department of Foreign Affairs of Ministry of Agriculture, Mr. Fei Kaiwei, Deputy Director, Department of Science and Technology of Ministry of Agriculture; Mr. Gong Guangum, Officer, Division of Asia and Africa of Department of Foreign Affairs of Ministry of Agriculture and Mr. Liu Guangning, Counsellor, Science and Technology, Chinese Embassy, Delhi, visited the Laboratory on March 2 and 3, 1989. The team appreciated the work being carried out in the Laboratory and showed a keen interest in the various research activities of the Laboratory.

A list of distinguished visitors to the Laboratory is given in Annexure III which also includes various ICAR officials.

Management Committee : The Management Committee of CTRL met on May 23, 1989. Apart from regular items such as confirmation of the minutes of the previous meeting, action taken on the recommendations of the committee, progress of expenditure, progress of works, action taken on the recommendations of the Institute Joint Council and Grievance Committee, new project proposals for 1989 were also considered. Progress of research during 1988 was considered and a programme of research work for the year 1989-90 was finalised.

Golden Jubilee Celebration of Quality Evaluation Unit of CTRL at Nanded: In connection with the completion of 50 years by the Regional Quality Evaluation Unit of CTRL at Nanded, a seminar on *Cotton Development* was organised on October 16 and 17, 1989 at the Cotton Research Station, Nanded. The seminar was inaugurated by Dr. P. V. Salvi, Vice-Chancellor,

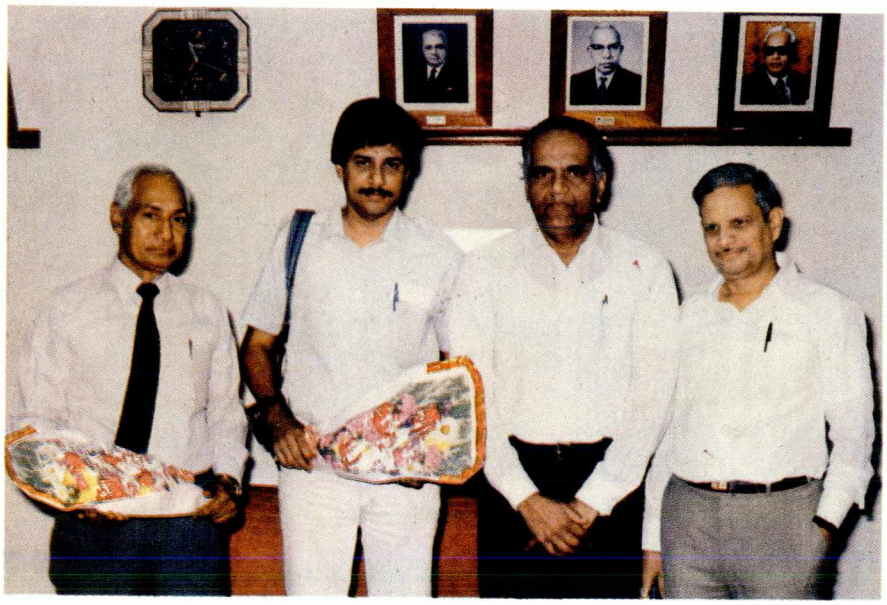
CHINESE AGRICULTURAL DELEGATION VISITS CTRL



His Excellency Mr. He Kang, Minister of Agriculture, is greeted by Dr. N. B. Patil, Director, CTRL

Chinese delegation with Dr. N. B. Patil, Director, CTRL

SHRI G. VENKATARAMANI, AGRICULTURAL CORRESPONDENT OF **HINDU** VISITS CTRL



Shri G. Venkataramani with Dr. N. B. Patil, Director, CTRL, Shri M. S. Parthasarathy, Principal Scientist, CTRL and Shri Kishan Kumar, Director (P&I), ICAR

Marathwada Agricultural University and was presided over by Dr. N. B. Patil, Director, CTRL. Dr. V. Sundaram, ex-Director, CTRL was the chief guest. The following special publications were released on the occasion :

1. A brochure containing lead papers, reminiscences and abstract of papers of the seminar and
2. A booklet written in Marathi on the importance of fibre tests in cotton research.

A total of 4 lead papers and 10 abstracts of papers were presented in addition to the reminiscences of people who were associated with this Regional Station.

Inauguration of New Regional Quality Evaluation Unit : The Thirteenth Regional Quality Evaluation Unit of CTRL which was inaugurated by Dr. N. B. Patil, Director, CTRL, started functioning at Sirsa (Haryana) at Central Insitute of Cotton Research Regional Station Campus with effect from December 27, 1989.

Jawaharlal Nehru Centenary Celebration: To commemorate the birth centenary of the first prime minister and the architect of modern India, essay competition in English and Hindi was organised on the topic *Role of Jawaharlal Nehru in Modernising Agriculture and Initiating Land Reforms*. Shri H. R. Laxmi Venkatesh, R. D. Nagarkar and S. Kumar Subramaniam received the first, second and third cash prizes of Rs. 100 Rs. 60 and Rs. 40 respectively for their essays in English and Shri R. C. Yadav, Smt. Santa Nayar and Smt. G. G. Palorkar received the first, second and third prizes, respectively for essays in Hindi. Prizes to the winners were distributed by Kum. Gayatri Narayanan, Professor, SIES College on November 16, 1989 at a special function organised for the purpose.

A lecture by Dr. V. S. Venkatavardan, Director, Nehru Planetorium on 'Nehrus' Vision of Science' was also organised in this connection, on February 28, 1989.

Internal Seminars: During January 1, 1989 to March 31, 1990, fourteen internal seminars were held as given below :

Sr. No.	*Topic*	*Date*	*Name of the speaker*
1.	Some Aspects of Cotton Production and Processing Technology in USSR	13-1-1989	Shri B. Srinathan
2.	Critical Analysis of Tenacity Measurement on HVT System	27-1-1989	Kum. I. K. P Iyer
3.	Some studies on the Short Range Thick Yarn Faults Estimated by Uster Classimat	27-1-1989	Shri B. Srinathan

Sr. No.	*Topic*	*Date*	*Name of the speaker*
4.	Seed cuts and Ginning	10-2-1989	Dr. N. C. Vizia
5.	Nutritional Aspects of Cotton Seed Oil	24-2-1989	Shri N. Thejappa
6.	An Introduction to the Technology of Knitting	4-3-1989	Shri S. Chandrashekar
7.	Influence of Test Length on Yarn Strength	18-3-1989	Shri G. F. S. Hussain
8.	Weft Knitting and Designing	12-4-1989	Shri Muntazir Ahmed
9.	Preparation and Properties of Super Absorbents	27-4-1989	Smt. Vatsala Iyer
10.	Visco-Elasticity in Textile Fibres	27-7-1989	Shri D. Rama Rao
11.	Infrared Spectroscopy and its Application to Cellulosics	19-8-1989	Dr. (Smt.) P. Bhama Iyer
12.	Protein Characterization on Amino Acid Analyser	16-9-1989	Dr. R. H. Bala-subramanya
13.	Applications of High Performance Liquid chromatograph in Analytical chemistry	16-9-1989	Shri N. Thejappa
14.	Evaluation of Fabric Properties	21-10-1989	Dr. K. R. Krishna Iyer

Staff Research Council : Two Staff Research Council Meetings were held during the period. The first meeting (eighty-eighth meeting) was held on March 7, 13, 15, 23 and 28 and a final session with the Management Committee on May 23, 1989. In this meeting progress of research work during 1988 was discussed and a programme of work for 1989-90 was finalised. Dr. N. B. Patil, Director chaired all the sessions.

The second meeting on January 25, March 13, 14 and 15, 1990, covered the progress of research work in various divisions/sections during the period January 1, 1989 to September 30, 1989. Dr. N. B. Patil,

REGIONAL QUALITY EVALUATION UNIT AT NANDED
COMPLETES FIFTY YEARS

Welcome Address by Dr. P. A. Deshmukh, Director of Research, MAU. Parbhani at the Seminar on **Cotton Development** *: Seated are : (from L to R) : Dr. P. G. Thombre, Cotton Specialist, MAU. Nanded, Dr. Ingle, Director of Extension Education, Parbhani, Dr. N. B. Patil, Director, CTRL, Dr. P. V. Salvi, Vice-Chanceller. Konkan Krishi Vidyapeeth, Dapoli, Dr. V. Sundaram, Retd. Director, CTRL, Dr. N. L. Bhale, Retd. Director, CICR, Nagpur and Shri J. K. Ratnaparkhi of Hexamer Research Foundation, Bombay*

A section of the Audience

NEW REGIONAL QUALITY EVALUATION UNIT OF CTRL AT SIRSA

Dr. N. B. Patil, Director, CTRL inaugurates the Sirsa Regional Quality Evaluation Unit

Director chaired all the sessions except session I which was chaired by Shri M. S. Parthasarathy, Principal Scientist. Heads of Divisions and Senior Scientists attended all the sessions while other Scientists and concerned Technical Officers attended their respective Divisional sessions.

Research Projects : In all, there were 52 on-going research projects grouped under six Thrust Areas, the details of which were as follows :

Thrust Area	*No. of research projects*
I. Technological Research for Cotton Quality Evaluation and Improvement	13
II. Post-Harvest Technology of Cotton	7
III. Structure, Property and their Inter-relationships in Textile Materials	13
IV. Chemical Processing and Finishing Treatments	6
V. Utilisation of By-products of Cotton and Processing wastes	11
VI. Origin of Cotton Dust and its Control	2

Implementation of Official Language (Hindi): A Hindi workshop in collaboration with the Directorate of Hindi Teaching Scheme, Bombay, was organised in the Laboratory from June 14 to 23, 1989, in which 46 employees of the Laboratory comprising Scientists, Technical and Administrative personnel participated.

As in the past, with a view to periodically review the implementation of Hindi as official language, an Official Language Implementation Committee was constituted and meetings of this committee were held every quarter under the chairmanship of the Director to appraise of the work done and also to chalk out future programmes for use of Hindi as official language at CTRL.

Hindi Day Celebration : The Hindi Day was celebrated with different programmes spread over from September 6 to 13, 1989 which included the following competitions for different categories of staff.

1. Quiz programme — "Uchit Shabd Kya Hai ?
2. Fill in the blanks (only for Group D and T-1 staff)
3. Essay competition
4. Kavya pathan
5. Hindi knowledge
6. Noting and drafting competition
7. Elocution contest

The function held on the final day which was presided over by Shri R. C. Rakesh, Joint Director, Directorate of Cotton Development, Bombay, had Dr. Shridhar Mishra, Head, Hindi Division, Guru Nanak Khalsa College, Matunga, Bombay as the chief guest. He also distributed prizes to winners of different competitions.

Post Graduate Training : The recognition granted to CTRL by the University of Bombay as post graduate institution was continued during this period. Nine students were being guided for M.Sc (4 for Textile Physics, 2 for Organic Chemistry, 2 for Physical Chemistry and 1 for Microbiology). Four students were being guided for Ph.D degree in Physics (Textiles).

In addition to the recognition given for Textile Chemistry and Textile Physics, permission has been granted to CTRL by the Executive Council of Bombay University for guiding students in M.Sc (Microbiology) for a period of two years from November 1989.

Dr. R. H. Balasubramanya, Scientist (SG) has been recognised as a teacher for Microbiology in addition to the following recognised guides.

1. Dr. V. Sundaram, Ex-Director
2. Dr. N. B. Patil, Director
3. Shri M. S. Parthasarathy, Principal Scientist (Mechanical Processing)
4. Dr. V. G. Munshi, Principal Scientist (Quality Evaluation)
5. Dr. K. R. Krishna Iyer, Principal Scientist (Physics)
6. Dr. P. K. Chidambareswaran, Principal Scientist (Physics)
7. Shri A. V. Ukidve, Scientist (S.G.), Physics
8. Dr. (Smt.) P. Bhama Iyer, Scientist (S.G.), Physics
9. Dr. K. M. Paralikar, Scientist (S.G.), Physics

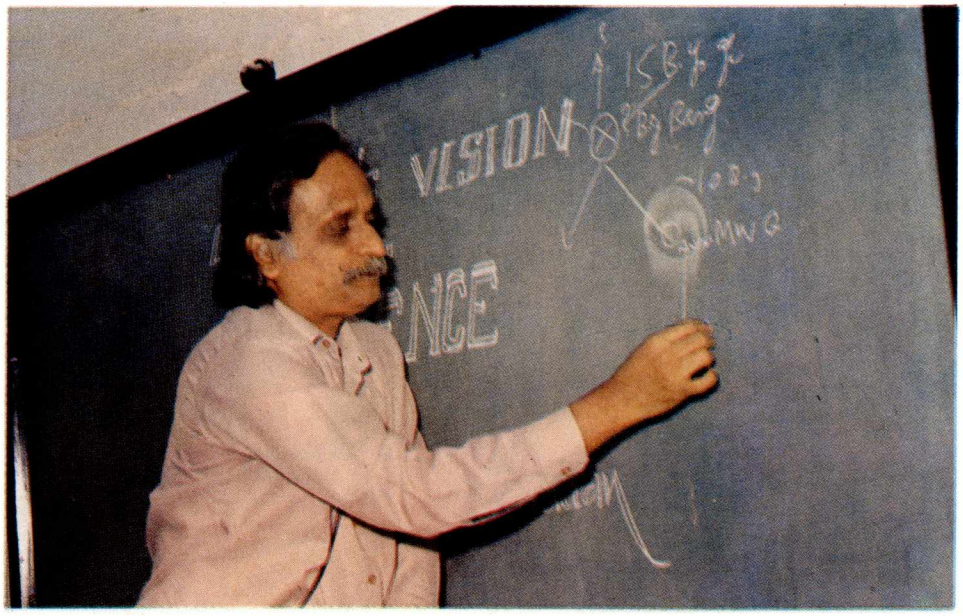
Membership in other Organisations : The Director, CTRL continued to be member of the following Committees/Bodies during the reporting period.

1. Cotton Advisory Board of the Office of the Textile Commissioner, Government of India, Ministry of Commerce, Bombay.
2. Board of Directors of the Cotton Corporation of India, Bombay.
3. Research Advisory Committee of the South India Textile Research Association (SITRA), Coimbatore.
4. Various Standing Committees of V.J.T.I., Bombay.
5. Cotton Development Council (Government of India) and Member of Sub-Committees on :
   (i) Research and Development
   (ii) Trade, Pricing and Exports
6. Member of the Textile Commissioner's Cotton Certification Committee.
7. Member of ICAR Scientific Panel for Post-Harvest Technology.

In addition, the Director and other Scientists of CTRL continued to represent CTRL/ICAR in various Committees of the Bureau of Indian Standards.

Institute Joint Council (IJC) : Four meetings of the IJC were held on 4-2-89, 2-5-89, 25-8-89 and 8-3-90 to discuss various matters of general interest to the staff.

Grievence Committee : Two meetings of the newly constituted Grievence Committee was held on October 26, 1989 and March 17, 1990.



Talk by Dr. V. S. Venkatavardan, Director, Nehru Planetorium on **Nehru's Vision of Science**

Kum. Gayatri Narayanan speaks on Nehru as the Architect of Modern India

Welcome address by Shri M. S. Parthasarathy, Principal Scientist at the Concluding Function of the Hindi Day Celebrations. Seated are : (from L to R) Dr. N. B. Patil, Director, CTRL, Dr. Shridhar Mishra, Head, Hindi Division, Guru Nanak Khalsa College, Matunga, Bombay, Shri R. C. Rakesh, Joint Director, Directorate of Cotton Development, Bombay

Hindi Class (Pragya) in progress with Shri L. B. Singh, the teacher sponsored by the Directorate of Hindi Teaching Scheme, Bombay

Finance : A statement showing sanctioned budget grant of CTRL and actual expenditure for the financial year 1988-89 and 1989-90 has been furnished in Annexure IV (a) and (b). As could be seen from the statement, the actual expenditure under non-plan was Rs. 1,12,80,287.20 and Rs. 1,31,90,025.00 as against sanctioned grant of Rs. 1,07,00,000.00 and Rs. 1,31,50,000.00 respectively for 1988-89 and 1989-90. Further an expenditure of Rs. 17,33,984.00 and Rs. 16,00,530.00 was incurred under the plan budget as against sanctioned grant of Rs. 20,00,000.00 and Rs. 16,00,000.00 respectively for 1988-89 and 1989-90. During 1988-89 and 1989-90, an expenditure of Rs. 58,906.05 and Rs. 40,934.00 was incurred under the PL-480 research project entitled "Cotton Fibre Tensile Properties in Relation to its Morphological and Fine Structure Parameters".

Significant Research Findings : In the panel meetings of different zones under the AICCIP, six new cotton varieties were recommended for release in different zones.

Results on the evaluation of spinnability of cottons from single thread strength of microspun yarns indicated that the tenacity values of single thread microspun yarns are less than that of full spun yarns and that the average percentage difference for all the count ranges was 6%. For all the counts, microspun yarn strength variation (C.V%) was much higher than that observed for the full spun yarn and the average percentage difference in CV gradually increased as the count increased (23% for 16s count to 31% for 50s count).

In a study on the contribution of ring frame process parameters to the fault levels of yarn spun from Indian cottons, it was observed that by increasing the noil extraction from 10% to 18%, there was an improvement in 50% span length and uniformity ratio. There is also a substantial reduction in the seed-coat fragment and trash. A significant improvement in overall yarn characteristics was found upto 14% noil extraction, but reduction in A, B and OBF (objectionable faults) continued upto 18% noil extraction.

The newly fabricated inclined type cotton pre-cleaning machine was found to be suitable for pre-cleaning all types of *Kapas*. By using 12mm × 12mm sieve, immature locks would also be removed from the *Kapas*. There was no fibre damage during the operation.

A survey of ginning factories of Madhya Pradesh was completed and a report on the findings was published incorporating the recommendations for improvement of overall ginning conditions in the factories.

The main findings on the investigations into the anatomy of yarn faults, their source of occurance and mechanism of formation were as follows :

(i) The strength drop of rotor spun polyester-viscose blended single yarn as compared to similar ring-spun yarn was as high as 24 to 29%.

(ii) The yarn spun on rotor-system is inferior in respect of evenness and elongation as compared to the yarns spun on ring frame.

(iii) As the polyester fibre denier goes coarser, the realisation in quality of rotor-spun single yarn improves, compared to the ring spun yarns.

(iv) In coarse doubled yarns, the realisation of rotor yarn quality over the ring yarn increases as the polyester becomes more coarser.

The following observations were made after analysing both ring and rotor yarn (single) for physical appearence of faults.

OBF category and B, C and D classes of faults in ring spun yarns : These faults are mostly coil like faults wherein, some fibres are wrapped in the form around the yarn body.

OBF in rotor spun yarns : Majority of faults are due to accumulation of excess fibres in a special form on the body of the yarn. Some faults with 'Waist Band' are also observed.

Aqueous solutions of LiOH and CsOH were identified as the most useful fine structural probes for cotton fibre and unless very fine details are needed, NaOH can be used in the place of CsOH.

Tests for tensile properties carried out on twenty-five cottons elicited many interesting observations on the structure-property relationship such as: (a) the cross sectional perimeter of fibres are characteristic of each variety (b) the packing density of fibrils in the cell walls of different varieties are markedly different (c) fibrillar spirality is the cause of convolution and the direction of convolution is the same as that of the fibrillar spirals in each length segment of the fibre flanking a structural reversal (d) the number of structural reversals vary among varieties as well as within each variety and (e) coarser varieties have lower tenacity though the breaking load does not exhibit any relation with linear density.

Crystallisation during the growth of cotton fibre showed a slowing down tendency during the intermediate stages of cell wall development.

Analysis of the structural and tensile behaviour of cotton fibres swollen in LiOH, NaOH and KOH at different temperatures indicated that KOH treatment was superior under certain specified experimental conditions.

The overall results of the modification treatments and cross linking carried out on cotton yarn as well as fabric indicated that a pre-treatment before resin finishing involving decrystalising with 20% NaOH and partially acetylating without washing off the alkali, has a beneficial effect on the fabric for the subsequent resin finishing operations. The modified and cross linked yarn and fabric exhibit a better balance of mechanical properties by way of higher strength retention without sacrificing the crease recovery property.

Soilability of cotton : Terene blended fabric can be decreased considerably by imparting antisoiling finishing treatment using carboxymethyl cellulose along with cross linking resin and certain softners.

The new antibacterial finish developed for cotton fabric showed good performance upto 30 launderings for all the treated fabrics.

The degree of polymerisation (D.P.) and the degree of whiteness varied from variety to variety, when 14 linter samples were subjected to identical conditions of kiering and bleaching.

INTRODUCTION

A proportion of 60:40 (coarse to fine) particle size was found to be ideal for multi-layered board preparation from cotton plant stalk. Boards prepared with 4.6% resin content and 20 Kg/cm^2 pressure have desirable properties of low density boards for insulation purpose. Particle boards prepared using 8%. Aerolite-CB as binder gave the properties meeting with the specifications of BIS.

Large scale trials undertaken for the preparation of pulp and paper from cotton plant stalk gave quite quite encouraging results about economic feasibility of preparation of good quality soda pulp and writing paper on a commercial scale.

When refined cotton seed oil samples were heated at 180° for varying periods, it was observed that the iodine value of heated oils decreased with increase in heating time, while anisidine and toluene) values increased. Changes were also observed in the IR spectra and UV spectra of heated oils as compared to untreated control on samples.

2

Progress of Research

Reports on progress of research during earlier years had been presented project-wise and discipline-wise. During this year, as per the directive from the council, six major thrust areas have been identified for the VIII Plan and on-going as well as new projects were grouped in these thrust areas with a view to accomplish mission oriented approach to problems well within the mandate of the Institute as well as of the ICAR. The broad thrust areas identified for CTRI. have been as follows :

1. Technological Research for Cotton Quality Evaluation and Improvement.
2. Post Harvest Technology of Cotton.
3. Structure, Property and their Inter-relationships in Textile Materials.
4. Chemical Processing and Finishing Treatments.
5. Utilisation of By-products of Cotton and Processing Wastes.
6. Origin of Cotton Dust and its Control.

The progress of research under each of the above thrust areas is given below :

THRUST AREA I : TECHNOLOGICAL RESEARCH FOR COTTON QUALITY EVALUATION AND IMPROVEMENT

This thrust area encompasses three distinct facets of technological research, viz. (a) Evaluation of the quality of cotton samples received from agricultural trials and the All India Co-ordinated Cotton Improvement Project (b) Tests on Standard and Trade Varieties of Indian Cottons, and (c) Specific research problems on agricultural and technological aspects relevant to the cotton improvement work.

(a) *Evaluation of Quality of Cotton Samples received from Agricultural Trials*

Large number of cotton samples are received every year for technological evaluation from various trials conducted by the All India Co-ordinated Cotton Improvement Project, state Departments of Agriculture and Agricultural Universities. The number of samples received from January 1, 1989 to March 31, 1990, for different tests are given in Table 1(a). The total number of samples tested at various Regional Quality Evaluation Units of CTRL is presented in Table 1(b). The samples received were tested in the order of priority and test reports were sent as soon as the tests are over. The test results on Trade Varieties and Standard Indian Cotton samples are issued in the form of periodical technological circulars and at the end of the year these are compiled for the whole season, printed and published as Technological Reports separately for Trade Varieties of Indian Cottons and Standard Indian Cottons.

A few samples are also received for some specific tests such as determination of quality of ginning, oil content in cotton seed, etc. and reports on these tests are also sent soon after the tests are completed.

Samples tested state-wise, for fibre characters and spinning performance have been given in Table 2.

(b) *All India Co-Ordinated Cotton Improvement Project (AICCIP)*

The AICCIP has completed 22 years since its inception in 1967. As the sowing and harvesting seasons for the cotton crop differ widely from state to state, the breeding programmes are formulated and conducted zone-wise. Thus, three zones, viz., North Zone, Central Zone and South Zone are identified according to the agro-climatic conditions. The breeding material from cotton breeders of various states is systematically screened every year and promising material is subjected to further screening. Maintenance of Germ Plasm and Initial Evaluation Trial are the preliminary stages in screening, while Co-ordinated Trials, Pilot Project Trials, etc., form the advanced trials in this Project. Data on economical, ancillary and technological characters are discussed in the panel meetings.

TABLE 1(a) : NUMBER OF COTTON SAMPLES RECEIVED FROM AGRICULTURAL TRIALS FOR DIFFERENT TESTS AT CTRL

Type of Test	Average for the quinquennium 1982-86	1987	1988	1989
Fibre and Full Spinning	126	157	205	235
Fibre and Microspinning	1797	1952	1851	1886
Microspinning alone	—	268	—	10
Fibre Test alone	235	482	83	668
Mill Test	8	8	17	4
Standard Cottons	15	20	13	16
Trade Varieties				
— Lint	31	46	18	22
— Kapas	43	40	25	16
Technological Research	120	—	45	4
Miscellaneous	20	—	5	6
Total	2485	2973	2262	2867

TABLE 1(b) : NUMBER OF SAMPLES TESTED AT THE REGIONAL QUALITY EVALUATION UNITS

Regional Quality Evaluation units	Quality Parameters				
	Fibre length	Fibre fineness	Fibre strength	Fibre maturity	Micro spinning tests
Akola	1656	746	746	746	—
Coimbatore	2176	2176	2176	2176	800
Dharwad	1838	1838	1873	2000	—
Guntur	567	600	679	530	—
Hisar	1087	912	1121	925	—
Indore	457	457	457	457	—
Ludhiana	1192	686	660	686	—
Nagpur	1469	1351	1362	1357	—
Nanded	1225	1225	1225	1225	—
Rahuri	1289	1289	1289	1289	—
Sriganganagar	1503	1503	924	1423	—
Surat	10687	5117	5396	6731	110
Sirsa †	—	—	—	—	—

† QE Unit of CTRL at Sirsa was established only on December 20, 1989

TABLE 2 : NUMBER OF SAMPLES TESTED AND REPORTS SENT DURING 1989-90

State	Fibre and Full spinning	Fibre and Micro-spinning	Fibre Test alone	Total
Punjab	34 (5)	92 (10)	16 (1)	142 (16)
Haryana	21 (4)	46 (8)	8 (1)	75 (13)
Rajasthan	13 (2)	29 (3)	—	42 (5)
New Delhi (IARI)	11 (2)	83 (5)	81 (3)	175 (10)
Madhya Pradesh	3 (1)	65 (7)	—	68 (8)
Gujarat	6 (1)	14 (2)	34 (4)	54 (7)
Maharashtra	28 (6)	306 (43)	134 (8)	468 (57)
Andhra Pradesh	8 (4)	27 (3)	—	35 (7)
Karnataka	6 (2)	353 (24)	15 (3)	374 (29)
Tamil Nadu	10 (3)	91 (7)	10 (1)	111 (11)
Total	140 (30)	1106 (112)	298 (21)	1544 (163)

Note : Figures in brackets indicate the number of reports sent.

As many as 1544 samples were screened for fibre properties and spinning potential during the year. Test data on various trials were presented at the panel meetings of the respective zones, viz. Akola for Central Zone, Kanpur for North Zone and Aduthurai for South Zone. The work done under various breeding trials is summarised below :

North Zone : North Zone comprises the states of Punjab, Haryana, Rajasthan, Uttar Pradesh and Delhi. As most of the area in this zone is under irrigation, the yield levels are considerably higher as compared to other zones. This zone is mainly known for its medium and superior medium staple American *G. hirsutum* and short staple *G. arboreum* types of cottons. The main object of the trials in this zone is to identify strains superior in quality/yield to the existing ones. Emphasis is also given to evolve strains which are early maturing or of short duration with a sowing to harvesting period of 150 days for making the field available for a second crop of food grains. Trials of the North Zone were also conducted at Padegaon which is in the Deccan Region of Maharashtra, where cotton is grown under irrigated conditions and the crop is sown in April, without waiting for the onset of monsoon.

G. hirsutum Trials : The *Co-ordinated Varietal Trials* (CVT) for Normal Plant Type as well as *Compact Plant Type and Short Duration* were conducted at Faridkot, Hisar, Ludhiana, Muktsar, Sirsa and Sriganganagar. Table 3 shows the ranges of 2.5% span length, Micronaire fineness and bundle strength along with maturity and spinning potential for the samples tried in both the trials.

The strains which recorded encouraging spinning performance at 30s and 40s counts at different locations under these two trials are given below :

Location	*Count*	*Promising strains*
Faridkot	40s	F.1054, LH.922, LH.944, LH.900 and B.N.
	30s	F.846, LH.1031, F.821, F.806, LH.1130, F.505 and B.N.
Hisar	30s	H.1101, F.1054, LH.944, H.1066, LH.922, H.974, HS.137, LH.1078, H.777 and B.N.
Ludhiana	30s	LH.886, LH.986, LH.1031, LH.1078, LH.1130, LH.1134, LH.1050, HS(CP)33, Pusa.39, F.505 and B.N.
Muktsar	30s	LH.1031, LH.1134, LH.986, LH.1076, LH.944, LH.922, LH.1050, LH.900 and B.N.
Sirsa	40s	HS(CP)33 and RS.751
	30s	H.974, CSH.485, LH.1130, HS.137 and H.777
Sriganganagar	30s	RST.19, CSH.485, RST.9, LH.922, F.1122 and B.N.

TABLE 3 : SUMMARY OF TEST RESULTS OF STRAINS TRIED IN CO-ORDINATED VARIETAL TRIAL OF G. HIRSUTUM IN NORTH ZONE

Location	No. of samples	Ranges of				Count	Spinning performance		Control Variety
		2.5% span length (mm)	Micronaire value (µg/in)	Maturity (%)	Bundle strength (g/t)		A	B	
1	2	3	4	5	6	7	8	9	10
				Normal Plant Type — Br 04 (a)					
Faridkot	9 F	23.4 — 26.9 (25.3)	4.3 — 5.2 (4.6)	70 — 81 (76)	45.6 — 50.4 (47.5)	30s	7	3	F.505
Hisar	7 F	22.5 — 25.0 (23.8)	3.9 — 4.3 (4.1)	74 — 82 (77)	44.0 — 50.4 (47.3)	30s	7	3	H.777
Ludhiana	8 F	23.0 — 26.9 (24.4)	3.7 — 4.5 (4.1)	68 — 80 (76)	46.1 — 49.8 (47.8)	30s	8	—	F.505
Muktsar	7 F	22.1 — 24.0 (24.0)	4.2 — 5.4 (4.8)	75 — 80 (78)	46.6 — 49.8 (47.8)	30s	5	5	F.505
Sirsa	6 M	22.6 — 24.8 (23.9)	4.9 — 5.4 (5.1)	75 — 86 (80)	45.6 — 52.0 (48.2)	30s	5	4	H.777
Sriganganagar	6 F	23.5 — 26.2 (24.4)	4.0 — 5.6 (4.7)	64 — 87 (74)	46.1 — 50.9 (48.0)	30s	3	—	—

Table 3. contd.

1	2	3	4	5	6	7	8	9	10
			Compact Plant and Early Maturing Type — Br 04 (b)						
Faridkot	8 M	23.4 — 27.2 (25.5)	3.9 — 4.9 (4.5)	70 — 83 (76)	41.8 — 49.8 (46.0)	40s	5	5	F.505
Hisar	6 F	23.5 — 25.4 (24.4)	4.0— 4.8 (4.5)	72 — 80 (76)	44.5 — 49.8 (47.5)	30s	4	—	H.777
Ludhiana	5 F	23.4 — 27.2 (25.4)	3.6 — 4.1 (3.9)	74 — 79 (77)	44.5 — 46.1 (44.9)	30s	3	—	F.505
Muktsar	5 F	22.7 — 26.9 (25.1)	4.5 — 5.3 (4.9)	74 — 85 (78)	46.6 — 49.8 (48.4)	30s	4	4	F.505
Sirsa	6 M	22.9 — 27.1 (24.7)	4.5 — 5.2 (4.8)	74 — 80 (77)	45.0 — 49.3 (47.7)	40s	2	2	H.777
Sriganganagar	7 F	24.0 — 26.7 (25.1)	4.0 — 5.1 (4.5)	75 — 89 (82)	45.0 — 48.8 (47.3)	30s	3	4	B.N.

A — Samples spinnable to the count chosen
B — Samples having spinning performance **on par** or better than the control
F — Full spinning
M — Microspinning
Note — Values in bracket indicate averages

Samples pertaining to *Preliminary Varietal Trial (PVT)* were received from Faridkot, Hisar, Ludhiana, Muktsar, Sirsa and Sriganganagar. The following strains fared well in spinning performance at 20s, 30s and 40s counts at the locations indicated below :

Location	*Count*	*Promising strains*
Faridkot	40s	F.965
Ludhiana	30s	LH.1120, F.1094, B.N. and F.505
Muktsar	30s	LH.1126, LH.1120, LH.1142, B.N. and F.505
Sirsa	30s	HS.84-1, HS.140 and H.777
Sriganganagar	20s	RS.716, LH.1120, HS.164, CSH.385, H.1021, B.N. and G.ageti.

The *Initial Evaluation Varietal Trial* (IEVT) was conducted at Faridkot, Hisar, Ludhiana, Muktsar and Sirsa. The following strains recorded satisfactory yarn strength at 30s and 40s counts at the locations indicated below :

Location	*Count*	*Promising strains*
Faridkot	40s	F.1086, F.1084 and HS.145
Hisar	40s	H.777
Ludhiana	40s	B.N.
Sirsa	30s	RS.795, LH.1009 and H.777

G. arboreum Trials : The Co-ordinated Varietal Trial for *G. arboreum* was conducted at Hisar, Ludhiana and Sriganganagar.

The object of this trial was to identify coarse, short staple and high ginning outturn varieties suitable for blending purposes in the place of the existing variety, G.27. The 2.5% span length of the strains tested under this trial ranged between 16.7 mm and 23.0 mm. The Micronaire value of the following samples was higher than 7.0 μg/in at the locations indicated :

Location	*Promising strains*
Hisar	HD.107 and DS.5
Ludhiana	LD.327 and HD.107
Sriganganagar	CSA.9-8, G.1 and RG.8

Samples pertaining to *Preliminary Varietal Trial* under this programme were received from Ludhiana only. The objective of this trial was to evolve high yielding superior cottons for spinning coarser counts. However, none of the strains was found spinnable to 20s count.

Hybrid Trials : *Intra-hirsutum* hybrids involving *hirsutum* × *hirsutum* crosses were tried at Faridkot, Hisar, Ludhiana, Sirsa and Sriganganagar. The range of 2.5% span length was between 22.8 mm and 28.1 mm. Micronaire value ranged between 3.6 μg/in and 5.4 μg/in. Maturity was average to good. Bundle strength values were good varying from 44.5 g/t to 51.5 g/t. The following hybrids fared well in spinning performance at the counts and the locations given below :

Location	*Count*	*Promising hybrids*
Faridkot	40s	FHH.3, FHH.5, CNHH.2 and GHH.334
Hisar	40s	HHH.81, PCHH.21 and FHH.3
Ludhiana	30s	PCHH.13, PCHH.20, PCHH.21, PCHH.31, GHH.334, B.N. and F.505
Sirsa	30s	CNHH.1, GHH.334, HS.45, HHH.11 and FHH.3
Sriganganagar	20s	PCHH.13, PCHH.21, FHH.3, HHH.11, RAHH.3, B.N. and G.Ageti.

Miscellaneous Trials : A good number of trials having different objectives were conducted at I.A.R.I., New Delhi in which a large number of cultures of *G. hirsutum* and *G. barbadense* recorded appreciably high fibre bundle strength besides having a spinning potential upto 60s count (in the case interspecific hybrids, upto 80s count as compared to any other cotton under the North Zone agro-climatic conditions). The details of the trials and test results are given below :

Two sets of lint samples of 32 and 31 each of Pusa cultures of *G. hirsutum* and *G. barbadense*, respectively were received with a view to screen the materials for high fibre bundle strength with a PSI value of 10.5 lb/mg (53.6 g/t) and above for further selection before next sowing. It was observ-

ed that none of the cultures recorded desired bundle strength value except the culture, Pusa. 24 belonging to *G. barbadense*. However, in another set of samples under the trial of Pusa selections of *G. hirsutum*, as many as eight selections could satisfy the objective of the trial by recording PSI values 10.5 Ib/mg and above.

Eleven samples, two from the *Pusa Cultures Trial* and nine from the *Advance Stage Selection Trial* were received for assessment of spinning potential. Both the Pusa cultures, viz. Pusa 45-3-3 and Pusa 45-3-4 recorded satisfactory spinning performance at 60s count while from the *Advance stage selection Trial*, two strains, viz. Pusa 45-2-6 and Pusa 45-3-6 were found suitable for spinning at 60s count, four strains, viz. Pusa 8, Pusa 22-1. Pusa 39 and Pusa 54-2-3 at 50s count and two strains, viz. Pusa 32 and Pusa 45-2-5 at 40s count.

In another trial of Pusa cultures of *G. hirsutum*, three different sets of samples were received for screening the material for spinning potential at 50s count. It was observed that only three out of twenty four cultures, viz. Pusa 31-38-8, Pusa N-13-19-13 and Pusa N-3-19-38, six out of fourteen cultures, viz. Pusa 188-11-5, Pusa 188-4-11, Pusa 188-4-13, Pusa 188-4-28, Pusa 188-6-3 and Pusa 188-6-5 and as many as thirteen out of twenty-nine cultures, viz. 8-1-32, 45-2-5-19, 5.B.(45-2-6), 8.B.(45-3-6), 45-2-6-3, 45-2-6-33, 45-2-6-52, 45-3-4-32, 45-3-6-6, 45-3-6-27, 45-3-6-57, 45-3-6-99 and 8-1-4 fared well in spinning performance at 50s count.

In *G. barbadense* Trial of Pusa Selection, as many as five out of seven cultures, viz. 16-13-4, 16-14, 17-6-1-1, Pusa 24 and 17-6-1 recorded encouraging CSP values at 80s count.

It was noted that in the Inter-specific Hybrid Trial under the agro-climatic conditions of this zone conducted at New Delhi, as many as eight out of nine hybrids, viz. 16-104-113, 16-114-123, 16-129, 16-131, 16-175-176, 16-177-178, 18-179-182 and 16-203 recorded desired yarn strength at 80s count.

Central Zone : The Central Zone comprising the states of Madhya Pradesh, Maharashtra and Gujarat has the largest area under cotton cultivation. Although emphasis is given to improve the existing American types of cotton, a sizable percentage of cottons from *G. arboreum* species is also under cultivation as most of the area, especially in Madhya Pradesh or Maharashtra, is under rainfed cultivation. For over a decade, Hybrid 4 has been widely accepted in all the three states. However, attempts are being made to identify early maturing hybrids without sacrificing the yield. Trials are also conducted for improvement in *G. herbaceum* species, which is traditionally grown in some pockets in Gujarat State.

G. hirsutum Trial : In the *Co-ordinated Varietal Trials (CVT)*, samples were received from Rahuri, Surat and Talod under irrigated conditions, from Akola, Jalgaon, Khandwa, Nanded, Parbhani and Somnathpur (Udgir) under rainfed conditions and from Padegaon under high ginning type cottons.

Summary of the test results has been given in Table 4. The following strains recorded desired CSP values at the locations

TABLE 4: SUMMARY OF TEST RESULTS OF STRAINS TRIED IN CO-ORDINATED VARIETAL TRIAL OF G. HIRSUTUM, IN CENTRAL ZONE

Location	No. of samples	Ranges of				Count	Spinning performance		Control Variety
		2.5% span length (mm)	Micronaire value (μg/in)	Maturity (%)	Bundle strength (g/t)		A	B	
1	2	3	4	5	6	7	8	9	10
				Br 04 (a) — Irrigated Trial					
Rahuri	14 FT	23.9 — 27.0 (25.9)	2.8 — 3.4 (3.1)	—	41.3 — 45.0 (43.5)	—	—	—	KOP.498
Surat	7 FT	24.8 — 29.1 (27.1)	2.6 — 3.8 (3.2)	—	44.0 — 46.1 (45.0)	—	—	—	Suman
Talad	7 M	23.6 — 27.4 (25.8)	3.4 — 4.6 (4.0)	69 — 79 (72)	45.0 — 51.5 (47.2)	50s	3	2	G.Cot.14
				Br 04 (b) — Rainfed Trial					
Akola	5 M	25.0 — 26.4 (25.9)	3.7 — 4.1 (3.9)	75 — 78 (76)	41.3 — 42.9 (42.0)	40s	—	2	DHY.286
Jalgaon	14 M	22.1 — 28.2 (24.5)	2.4 — 4.5 (3.5)	52 — 81 (71)	40.7 — 46.6 (44.0)	40s	2	3	PKV.081
Khandwa	14 M	23.8 — 28.6 (25.7)	3.1 — 4.1 (3.8)	68 — 79 (76)	42.9 — 49.8 (46.9)	40s	9	—	Khandwa.3

Table 4. contd.

1	2	3	4	5	6	7	8	9	10
Khandwa	4 M	23.4 — 24.5 (24.0)	3.1 — 3.7 (3.2)	60 — 70 (64)	41.8 — 45.6 (44.1)	40s	1	—	—
Nanded	5 M	23.9 — 26.4 (25.4)	3.5 — 4.4 (3.9)	58 — 70 (63)	40.2 — 46.1 (43.7)	30s	5	—	Purnima
Parbhani	4 M	22.9 — 29.1 (25.0)	2.8 — 3.4 (3.1)	56 — 74 (67)	44.5 — 47.7 (45.7)	40s	1	—	—
Somnathpur	6 M	23.2 — 28.6 (24.5)	4.0 — 5.0 (4.4)	61 — 77 (69)	42.3 — 46.6 (44.1)	40s	—	1	Purnima
			Br 04 (c) — High Ginning Type						
Padegaon	18 M	22.8 — 26.6 (25.1)	2.8 — 4.6 (3.4)	49 — 77 (68)	40.2 — 46.6 (42.7)	40s	4	1	KOP.498

A — Samples spinnable to the count selected

B — Samples having spinning performance **on par** or better the control

M — Microspinning

FT — Fibre Test only

Note — Values in brackets indicate averages

and counts given below :

Location	*Count*	*Promising strains*
		Irrigated
Talod	50s	G.4814, Supriya and G.Cot.14
		Rainfed
Jalgaon	40s	PH.23 and JLH.109
Khandwa	40s	G.2449, G.2987, PH.39, JLH.109, 79.BH.5-3, KH.81-1911, AKH.8240, WH.216, G.Cot.10 and Khandwa 3
Nanded	30s	PH.93, G.4406, PH.39, G.Cot.10 and Purnima
Parbhani	40s	79.BH.5-3
		High Ginning Type
Padegaon	40s	JK.345, LRA.5166, LRK.516 and KOP.498

Samples pertaining to *Preliminary Varietal Trial* were received from Rahuri and Talod under irrigated conditions and from Akola, Jalgaon, Khandwa and Nanded under rainfed conditions. The following strains recorded satisfacatory spinning performance at the locations and the counts indicated below :

Location	*Count*	*Promising strains*
		Irrigated
Talod	50s	G(T).538
Jalgaon	40s	G. 84-909
Khandwa	40s	JLH.109, NH.293, G.1630, G.84-909, G.Cot.10 and Khandwa 3
Nanded	40s	PH.99 and G.Cot.10

Initial Evaluation Varietal Trial was conducted at Badnapur and Rahuri under irrigated conditions and at Akola, Badnawar, Jalgaon and Khandwa under rainfed conditions. All the six strains, viz. NH.382, NHH.44, PH.99, PH.93, NH.380 along with the control, PKV.081 from Badnapur recorded encouraging spinning performance at 30s count and three out of five strains, viz. G.3932, G.48-909 including the control, G.Cot.10 from Khandwa recorded desired CSP values at 40s count.

G. arboreum Trial : The Co-ordinated Varietal Trial was conducted at Akola and Jalgaon.

Three out of nineteen strains, viz. 35N, NA.336 along with the control, AKH.4 from Jalgaon gave satisfactory yarn strength at 20s count.

G. herbaceum Trial : *The Co-ordinated Varietal Trial* of *G. herbaceum* was conducted under irrigated conditions at Surat.

Only three strains, viz. GH.129-85, GH.458/1165 along with the control, G.Cot.11 recorded satisfactory spinning performance at 30s count.

Hybrid Trial : The object of this trial was to identify hybrids superior in yield and quality to the existing local hybrids, viz. Hybrid 4, bKHy. 1, *G. Cot* Hy.6, Godavari, etc. in Gujarat, Madhya Pradesh and Maharashtra, either under irrigated or rainfed conditions.

Intra-hirsutum Hybrid Trial : Samples pertaining to this trial were received from Aurangabad Padegaon, Rahuri and Surat under irrigated conditions and from Akola, Jalgaon, Khandwa, Nanded and Parbhani under rainfed conditions.

The promising hybrids at different locations and counts are indicated below :

Location	*Count*	*Promising hybrids*
Akola	40s	JKHy.2, WHH.90 and AHH.468
Aurangabad	40s	MECH.94, MECH.98, MECH.134, MECH.138, GHH.662, WHH.204, NHH.307, JKHy.2, PHH.146, PHH.204 and Hybrid 4
Jalgaon	40s	GHH.662, NHH.300, NHH.302, JKHy.2 and Hybrid 6
Khandwa	40s	WHH.90, NHH.302, JKHy.2, WHH.204 and JKHy.1
Nanded	40s	NHH.302
Parbhani	40s	WHH.90, NHH.307 and NHH.44

Inter-specific Hybrid Trial : The Inter-specific Hybrid Trial involving *G. hirsutum* × *G. barbadense* crosses was conducted at Nanded, Parbhani, Padegaon and Surat under irrigated conditions.

The promising hybrids at different locations which fared well in spinning performance at 60s count are indicated below :

Location	*Promising hybrids*
Nanded	NHB.29, PHB.60, NHB.28, NHB.12 and DCH.32
Parbhani	NHH.5166 and MECH.109
Padegaon	RHB.01187, RHB.0287, RHB.0487 and RHB.0187

Efforts were under way to evolve *desi* hybrids involving *G. arboreum* × *G. herbaceum* crosses for higher yields. Samples of *desi* hybrid were received from Akola, Aurangabad and Jalgaon. The two hybrids, viz. GDH.149 and GDH.160 had 2.5% span length more than 28.8 mm, Micronaire value less than 4.1 μg/in and good bundle strength value of 48.8 g/t and above at zero gauge length. The hybrid, GDH.149, at Akola was spinnable to 30s count with a CSP value of 1953, while at Jalgaon, the hybrids, GDH.149 and GDH.160 recorded poor CSP values of 1778 and 1871, respectively at 40s count. The other promising hybrids, viz. MDCH.202 and G.Cot.Hy.7 including the control variety, Y.1, were found suitable for coarser count of 20s.

Evaluation of Dwarf and compact plant Types : Dwarf and compact type of plants have certain advanges in respect of yield over the normal type of plants. In order to study the yield and the technological aspects of such plant types, trials were conducted at Akola, Jalgaon and Nagpur. The following strains recorded encouraging spinning performance at the counts and the locations indicated below :

Location	*Count*	*Promising strains*
Akola	40s	LRK.516
Jalgaon	40s	G(T)966, KD(CAKD) and PKV.081
Nagpur	20s	NISD.3

Miscellaneous Trial : A few miscellaneous trials having different objectives were conducted at different locations. Results of these trials are as given below :

A set of three cotton samples, viz. Khandwa *(G. hirsutum)*, Sarvottam (*G. arboreum*) and JKHy. 2 (Intra-specific hybrid), were received from Khandwa. Two cottons, Khandwa 2 and Sarvottam were almost *on par* in fibre length and maturity. Both these cottons were found suitable for spinning to 20s count. The inter-specific hybrid, JKHy. 2 with good length uniformity, fineness, maturity and bundle strength, fared well in spinning performance at 50s count.

An *Intra-hirsutum* hybrid trial was conducted for a male sterile hybrid, MECH.4 along with Hybrid 4 as control at MAHYCO, Jalna. It was observed that Hybrid 4 recorded higher CSP values at both the counts spun, viz. 40s and 50s as compared to those of MECH.4, and Hybrid 4 gave desired CSP value at 40s count.

A new American type cotton strain, PH.93 (Nagnath) having high yielding potential with high GOT was tried along with the control variety, Purnima (NH.239) under rainfed conditions at Nanded. PH.93 recorded better CSP values at both the counts, of 30s and 40s. However, only PH.93 which were spinnable at 30s count was found satisfactory.

Two sets of 4 samples each from the miscellaneous trials of *G. hirsutum* were received from Nanded. As many as five strains, viz. PH.99, PH.93, NH.380 and NH.397 along with the control Purnima recorded encouraging CSP values at 40s count.

A good number of *Regional Varietal Trials* of *G. arboreum* were conducted at Nanded. As many as seven sets of seven samples each and one set of five, were received. A good number of strains recorded encouraging spinning performance at 30s count and these may be listed as; NA.260, NA.272, NA.315, NA.318, NA.326, NA.332, NA.336, NA.362, NA.365, NA.375, NA.376, NA.379, NA.380, NA.384, NA.385, NA.389, NA.399, NA.401, NA.403 and NA.407 including the control varieties PA.141, Eknath and Rohini.

Another set of two samples, viz., NHH.302 and the control, NHH.44, was received from Nanded under the Miscellaneous Trial of *Intra-hirsutum* Hybrids. It was observed that the new hybrid, NHH.302 was better in fibre length, maturity and bundle strength at both the gauge lengths as compared to the control hybrid, NHH.44. In the case of spinning performance, NHH.302 recorded superior CSP values at both the counts, viz. 30s and 40s, to those of NHH.44 NHH.302 and was found to give encouraging spinning performance at 40s count.

In a Miscellaneous Multi-location Trial of *G. hirsutum*, five samples were received from Padegaon. All the strains recorded fibre length covered by the long staple category of cotton with good length uniformity. However, none of these strains was found spinnable to 50s count, when subjected to micro-spining test.

Two sets of six samples each of *G. hirsutum* trial and one set of five samples under the Regional Trial were received from Somnathpur. Four strains of *G. hirsutum*, viz. PH.99, NH.380, LRA.5166 and an *intra-hirsutum* hybrid, NHH.44 were found spinnable to 40s count.

Under the Miscellaneous Trial of *G. arboreum*, two sets of six samples each and three sets of five samples each were received from Somnathpur. Five strains, viz. PA.85/150, PA.85/142, PA.136, NA.315 and NA.367 in addition to the two control varieties, viz. PA.141 and Eknath, fared well in spinning performance at 30s count.

In another Miscellaneous Trial of Intra-hirsutum Hybrids, five samples were received from Somnathpur. Out of these, four hybrids, viz. PHH.188, NHH.312, NHB.12 including the control hybrid, NHH.44 recorded desired yarn strength at 40s count.

South Zone: This zone comprising the states of Karnataka, Andhra Predesh and Tamil Nadu is known for its long and superior long staple cottons. Although cottons for *G. hirsutum* species occupy larger area under cultivation, cottons from *G. arboreum*, *G. herbaceum* and *G. barbadense* are also grown in some pockets of this zone, either in irrigated tracts or in rainfed tracts. *Intra-hirsutum* and *interspecific* hybrids are also cultivated on a large scale.

G. hirsutum Trial : Co-ordinated Varietal Trial was conducted at Coimbatore, Raichur and Siruguppa under irrigated conditions and at Dharwad, Raichur and Shimoga under rainfed conditions. The ranges of 2.5%

span length, Micronaire value, maturity and bundle strength along with their spinning performance are given in Table 5.

The following strains recorded satisfactory spinning performance at the counts and the locations indicated against them :

Location	*Count*	*Promising strains*
		Irrigated
Coimbatore	50s	TKH.4-3, HLS.321729, RKR.4145, LK.861 and MCU.5
Raichur	40s	TKH.4-3, LK.861 and CPD.415
Siruguppa	50s	TCH.1002, L.571, LK.861, NCBR.2-3/3, CPD.415, RAMP.69, ACP.71-12-3, TKH.4 3, HLS.321729, LRA.5166 and MCU.5
		Rainfed
Dharwad	50s	JK.276-4 and LRA.5166
Shimoga	40s	JK.276-4, HLS.321729, RAS.299-1, LRA.516 and G.Cot.14

Samples pertaining to Preliminary Varietal Trial were received from Arabhavi, Raichur and Coimbatore under irrigated conditions and from Dharwad, Raichur and Shimoga under rainfed conditions. The following strains recorded desired CSP values at the counts and the locations given below :

Location	*Count*	*Promising strains*
Arabhavi	50s	RAMP.10, NCBR.2-3/4, L.2, L.10, TCH.28, G.84-109, LRA.5166 and 170.CO2
	60s	NHYPS.152, TCH.1216, TCH.1217 and MCU.5
Raichur	40s	PS.20-12-2, NA.1290, NCBR.2-3/4, TCH.28, L.10, AH.133-5-1, TCH.1217, TCH.1001, CPD.408, NHYPS.152 and MCU.5
Coimbatore	50s	TCH.1216, TCH.1217, TCH.1218, NHYPS.152, MCU.11 and MCU.5
		Rainfed
Dharwad	40s	TCH.497, NA.1162, CPD.409, RAMP.411, TCH.560, JK.276-8-2, NA.1290, NA.1264, 2-182-8-7, JK.260, ARC.216, LRA.5166 and Sharada
Raichur	30s	JK.276-8-2 and LRA.5166
Shimoga	40s	TCH.497, JK.276-8-2, NA.1290, NA.1264, 3-199-1-1 and LRA.5166

TABLE 5 : SUMMARY OF TEST RESULTS OF STRAINS TRIED IN CO-ORDINATED VARIETAL TRIAL OF G. HIRSUTUM, IN SOUTH ZONE

Location	No. of samples	Ranges of				Count	Spinning performance		Control Variety
		2.5% span length (mm)	Micronaire value (μg/in)	Maturity (%)	Bundle strength (g/t)		A	B	
1	2	3	4	5	6	7	8	9	10
				Br 04 (a) — Irrigated Trial					
Coimbatore	15 M	24.4 — 32.3 (28.6)	3.5 — 4.7 (4.2)	—	19.2 — 26.6* (22.5)	50s	5	5	MCU.11
Raichur	16 M	24.5 — 29.6 (27.2)	2.1 — 3.7 (3.1)	55 — 80 (68)	41.8 — 48.2 (44.3)	40s	3	8	RAS.303
Siruguppa	16 M	24.2 — 35.6 (30.0)	2.6 — 4.4 (3.6)	—	41.3 — 49.3 (44.7)	50s	11	15	Sharada
				Br 04 (b) — Rainfed Trial					
Dharwad	10 M	23.1 — 30.6 (26.5)	3.3 — 5.2 (3.9)	61 — 80 (68)	41.8 — 46.1 (44.7)	50s	2	9	Sharada
Raichur	10 M	21.1 — 28.3 (23.9)	2.9 — 4.6 (3.6)	64 — 77 (69)	42.9 — 48.2 (45.9)	40s	—	—	Laxmi
Shimoga	10 M	25.8 — 30.1 (27.1)	3.3 — 5.3 (4.1)	60 — 86 (73)	42.3 — 47.2 (45.1)	40s	5	6	Sharada

* — 1/8" gauge tenacity
A — Samples spinnable to the count selected
B — Samples having spinning performance **on par** or better than the control
M — Microspinning
Note — Values in bracket indicate averages

G. barbadense Trial : The Co-ordinated Varietal Trial was conducted only at Raichur and as many as fourteen out of Eighteen strains, viz. RBS.14, TCB.355, BCS.9-95, TCB.295, BCS.23-18-7, IMS. 2721, TCB. 87-6, IMS.2722, GA.9-22. TCB.356, TCB.3521, C.17 and IMP.0131 including the control, Suvin fared well in spinning performance at 60s count.

G. herbaceum Trial : The *Co-ordinated Varietal Trial* was conducted only at Raichur under irrigated conditions. The ranges of 2.5% span length, Micronaire value and bundle strength of these samples were 19.1 mm to 23.4 mm, 3.4 μg/in to 4.8 μg/in and 44.0 g/t to 48.6 g/t, respectively. However, none of the strains fared well in spinning performance at 20s count.

Hybrid Trial : The hybrid trial involving *G. hirsutum* × *G. hirsutum* crosses was conducted at Coimbatore and Siruguppa under irrigated conditions and at Dharwad and Raichur under rainfed conditions. The following hybrids recorded desired yarn strength at the counts and locations given below :

Location	*Count*	*Promising hybrids*
		Irrigated
Coimbatore	50s	T13 × M12, DHH.10, TCHH.13, V54 × M12, NFHH.3, NHH.39, MECH.12, TCHH.33, ICMF.HH.14, Savitha, Shivnath and JKHy.1
Siruguppa	50s	DHH.10, DHH.11, NHH.198, GHH.334, CINHH.1, DHH.13, TCHH.13, TCHH.14, MECH.12, MECH.13, TCHH.13, TCHH.23, TCHH.33, TCHH.41 and NHH.39
		Rainfed
Dharwad	50s	MECH.94, MECH.16, MECH.44, ARCH.53 and Savitha

Inter-specific Hybrid Trial : The hybrids involving *G. hirsutum* × *G. barbadense* crosses were tried at Arabhavi and Raichur under irrigated conditions and those involving *G. arboreum* × *G. herbaceum* crosses at Raichur under rainfed conditions. The following hybrids fared well in spinning performance at the locations and counts indicated below :

Location	*Count*	*Promising hybrids*
		G. hirsutum × *G. barbadense*
Arabhavi	80s	H.224, H.226 and MECH.112
Raichur	80s	MECH.111, MECH.112 and H.226
		G. arboreum × *G. herbaceum*
Raichur	20s	NFDH.105

Miscellaneous Trials : A large number of trials having different objectives have been conducted at Arabhavi, Coimbatore, Dharwad, Mudhol, Nandyal and Shimoga.

A promising *G. herbaceum* selection, 5865 along with the control, Jayadhar was tried out at Adoni. It was observed that Jayadhar was significantly better in Micronaire fineness and bundle strength at zero gauge length than the new selection, 5865. Also, only Jayadhar was found satisfactorily spinnable to 16s count.

Two samples of superior long staple *intra-hirsutum* hybrid, viz. T13 × M12 and the control, JKHy.1 tried under irrigated conditions were received from Arabhavi. The new hybrid T13 × T12 was found to be superior in fibre length, bundle strength at 1/8" gauge length and spinning performance at 50s count, than the control, JKHy.1.

The miscellaneous trials of *G. hirsutum*, and *G. barbadense* species and of *Intra-hirsutum* and *interspecific* hybrids were conducted at Coimbatore.

In *G. hirsutum* trial under rainfed conditions, two out of four varieties, viz. 081 and SRT.1 exhibited good spinning potential at 40s count, while the other two, viz. LRK.516 and LRA.5166 gave satisfactory spinning performance at 50s count. In the other *G. hirsutum* trial, the following varieties recorded desired yarn strength at the count indicated in the bracket :

LRA 5166 (40s), LRK.516 (40s), M.12 (50s), Supriya (50s), T.7 (50s) and Suvin (80s).

In the *G. barbadense* trial, the ranges of 2.5% span length, Micronaire value and bundle strength were 30.0 mm to 37.1 mm, 2.2μg/in to 2.8μg/in and 46.1 g/t to 54.1 g/t, respectively. However, none of the strains fared well in spinning performance at 120s count.

In the long staple *Intra-hirsutum* hybrid trial, only two out of six hybrids, viz. V.54 × M 12 and V.59 × M 12 were found spinnable at 60s count, while in the medium staple *Intra-hirsutum* hybrid trial, as many as five out of fourteen hybrids, viz. V.22 × M.29, M.20 × M.37 and V.52 × M.12 including the two control, Savitha and LTA.5166 recorded desired CSP values at 50s count.

Two interspecific hybrids, viz. H.224 and DCH.32 received from Coimbatore were *on par* in fibre length, uniformity, maturity and Micronaire fineness. However, the new hybrid, H.224 was superior to the control hybrid, DCH.32 in bundle strength at both the gauge lengths. In the case of spinning performance, H.224 was found to give satisfactory spinning performance at 80s count, while, the control, DCH.32 recorded good CSP values at 60s count. The yarn of H.224 was more even and has less neps, thin and thick places as compared to that of DCH.32 at both 60s and 80s counts.

In a miscellaneous *Interspecific hybrid Trial* at Coimbatore, a set of eleven samples was received and as many as six hybrids, viz. H.224, H.225, H.226, H.544 and H.574 recorded encouraging CSP values at 80s count.

In another miscellaneous trial at Coimbatore, a set of four samples comprising two each of *G. hirsutum* and *Interspecific hybrid*

was received. It was observed that in the case of *G. hirsutum,* the control, MCU.11 was better in CSP value at 50s count than TCH.1002, while in the case of *Inter-specific hybrids,* both the hybrids viz. TCHB.213 and DCH.32 (control) were not found suitable for spinning to 60s count.

Under the seed production programme, samples of JK.119 and BCS.23-18-7 at different stages of bulk were received from Dharwad. It was observed that none of the samples of JK.119 and those of BCS.23-18-7 fared well in spinning performance, except the two controls, viz. Suvin and DCH.32 at 80s count.

Cotton samples were received from Mudhol under the *Improvement of Gaorani Scheme* for evolving *G. arboreum* cotton varieties better in yield and fibre properties than the Gaorani cottons, which are suitable for cultivation in the Gaorani tract under the rainfed conditions.

Under the *Advanced Varietal Trial* of *G. arboreum,* as many as seven out of ten cultures, viz. 1506, 1867, 1874, 2021, SB.171 and 2128 along with control, Saraswathi recorded encouraging CSP values at 30s count. However, the culture, 1867 showed good spinning potential only at 20s count when it was tested for full spinning along with another culture 1875.

Under the *Parents of Desi Hybrid cotton Trial,* only two out of nine parental strains viz. G.6 and 1874 showed encouraging yarn strength at 30s count, while under *Desi Hybrid Trial* as many as four out of ten hybrids, viz. MCA.23, MCA.26, MCA.35 and MCA.36 recorded good CSP values at 30s count.

Two sets of two samples each belonging to different trials were received from Nandyal. In the case of *G. hirsutum* trial under irrigated conditions, the new strain, NA.1290 was found to be superior in fibre length, fineness and bundle strength at $\frac{1}{8}''$ gauge length to those of the control, LRA.5166. Only NA.1290 recorded desired CSP value at 30s count. In the case of *Intra-hirsutum* hybrid trial under rainfed conditions, the new hybrid, NHH.39 was superior to the control hybrid, JKHy.1 in respect of fibre length, length uniformity and bundle strength at both the gauge lengths. In spinning performance also, NHH.39 was superior to JKHy. 1 and recorded encouraging CSP value at 50s count.

A trial of DCH.32 was conducted at Shimoga to study the variation in quality of cotton with different pickings. It was observed that almost all the fibre properties, viz. fibre length, Micronaire value, uniformity, bundle strength at zero length and the CSP value at 80s count. decreased with progressive picking of DCH.32, except in the case of fifth picking where the fibre properties and the CSP values were *on par* with those of I and II pickings. There was significant difference between the fibre properties and the CSP values of first and sixth (last) pickings.

Mill Test : Taking into consideration the results of field trials and the tests for fibre quality and spinning performance carried out at CTRL, selected improved varieties of cotton are subjected to actual tests under mill conditions to assess their spinning performance under these conditions. The recommendation for large scale cultivation of these new varieties will be generally made

TABLE 6: COMPARATIVE SPINNING TEST RESULTS AT MILL AND AT CTRL FORTHE YEAR 1989

Location	Variety	Mill Test					Laboratory Test				
		Count (Ne)	Strength (lb)	CSP	TM	U%	Count (Ne)	Strength (lb)	CSP	TM	U%
Hisar	H.974	30s	68.6	2057	4.8	18.5	30s	76.2	2217	4.0	16.3
		40s	—	—	—	—	40s	52.1	1968	4.0	17.3
	H.777 (C)	30s	79.0	2244	4.8	18.0	30s	77.0	2310	4.0	15.6
		40s	49.0	1958	4.9	19.0	40s	50.7	2028	4.0	16.6
Nanded	NHB.12	60s	47.1	2825	4.0	15.7	60s	42.9	2574	3.8	18.5
		80s	30.6	2445	4.5	17.1	80s	29.0	2320	3.8	19.2
	DCH.32 (C)	60s	45.4	2721	4.0	16.6	60s	43.6	2616	3.8	16.2
		80s	30.9	2473	4.5	17.0	80s	29.5	2360	3.8	18.7
Parbhani	PA.141	20s	107.9	2158	4.7	16.5	20s	109.0	2180	4.0	13.7
		30s	52.3	1569	4.7	19.4	30s	56.0	1707	4.0	18.0
	Rohini (C)	20s	95.5	1910	4.7	16.8	20s	110.6	2212	4.0	14.5
		30s	51.6	1548	4.7	20.6	30s	61.2	1836	4.0	18.4
Dharwad *	DDH.2	6s	283.3	1700	4.2	10.7	6s	284.3	1706	4.5	10.2
		10s	148.2	1482	4.2	12.2	8s	182.2	1822	4.5	11.8
	Jayadhar (C)	6s	275.2	1651	4.2	10.4	6s	259.2	1555	4.5	10.6
		10s	153.4	1534	4.2	11.8	8s	159.0	1590	4.5	9.8

C — Control variety

* Samples were spun by openend spinning technique.

only after their performance under mill conditions is confirmed. This Laboratory arranges mill tests on the new promising strains in co-operation with some of the textile mills in the country.

During the period, mill tests were arranged for samples received from Hisar of North Zone, from Nanded and Parbhani of Central Zone and from Dharwad of South Zone and the test results are incorporated in Table 6.

The improved variety, H.974 received from Hisar was lower in CSP value at 30s count than the control variety, H.777 both at the mill and at the Laboratory. Also H.974 gave satisfactory spinning performance at 30s count at the mill, while the control variety, H.777 recorded good CSP value at 40s count in the Laboratory. It was also observed that the spinning performance of these two cottons was superior at the Laboratory to that at the mill, inspite of the higher twist multiplier used at the mill.

The new improved inter-specific hybrid, NHB.12 as well as the control, DCH.32 received from Nanded recorded satisfactory spinning performance both at the mill and at the Laboratory at 80s count (carded). The CSP values recorded by NHB.12 at both the counts, viz. 60s and 80s were almost *on par* with those recorded by DCH.32. It was also observed that the spinning performance of these two hybrids was superior at the mill level to that at the Laboratory level at both the carded counts. This was possible due to higher levels of twist used at the mills and differences in processing conditions.

The CSP value at 20s count recorded by the new *G. arboreum* strain, PA.141 received from Parbhani was superior to the control variety, Rohini at the mill, while at the Laboratory, there was no significant difference in yarn strength at 20s count between these two cottons. Both these cottons showed good spinning performance at 20s count both at the mill and at the Laboratory.

In the case of fibre properties, *desi* hybrid DDH.2, received from Dharwad, was *on par* with the control variety, Jayadhar in mean fibre length. DDH.2 was coarser in Micronaire fineness and better in strength at both the gauge lengths than Jayadhar. In the case of spinning performance by open end spinning, DDH.2 recorded better CSP value at 6s count than Jayadhar both at the mill and at the Laboratory. However, in the case of spinning performance at 10s count, the CSP value for DDH.2 was lower than that for Jayadhar at the mill, while DDH.2 recorded higher CSP value than Jayadhar at the Laboratory.

New Cotton Varieties Recommended for Release : 1. LH.1134: This is a long staple cotton variety with 2.5% span length of 27.8mm and spinning potential of 40s count. This variety is of normal plant type and short duration of 170-175 days maturity with a high ginning percentage of 35.6. Superior in yield to the existing varieties of F.505 and B.N, this variety is adaptable throughout Punjab State.

2. *NHB*.12 : This is an extra-long staple interspecific hybrid cotton, capable of spinning to 80s count. This hybrid is suitable for cultivation in the Marathwada region

and its adjoining areas where DCH.32 is grown. This hybrid is high yielding and early maturing as compared to the existing hybrid cotton, DCH.32.

3. *CICR.HH.*1: This is a superior medium staple *intra-hirsutum* hybrid cotton having high ginning percentage of 35 and capable of spinning to 40s count. It matures in 160 days and is suitable for cultivation in selected areas of Marathwada of Maharashtra State under rainfed conditions and Bharuch of Gujarat and Banswara of Rajasthan under irrigated conditions.

4. *HB.*224 :This interspecific hybrid is an extra-long staple cotton capable of spinning between 60s and 80s counts. This hybrid is high yielding as compared to the existing local hybrid, DCH.32 and is suitable for cultivation in the irrigated areas of southern states of Tamil Nadu, Andhra Pradesh and Karnataka.

5. *DDH.*2 : This *desi* hybrid is of medium staple with high Micronaire value and good bundle strength at both the gauge lengths. This cotton gives satisfactory spinning performance at 20s count in ring spinning and at 6s-8s count in open-end spinning. This hybrid matures in 180-185 days and is superior in yield to the local varieties of Jayadhar, Suyodhar, DB.3-12 and R.51 and is ideally suited for cultivation under rainfed conditions in the areas of Karnataka and Andhra Pradesh of South Zone.

6. *MECH.*4 : Cytoplasmic male sterile based *intra-hirsutum hybrid,* MECH.4 was recommended for release in Marathwada tract of Maharashtra and Banswara tract of Rajasthan in view of its superiority in yield over the local hybrids, NHH.44, Hybrid 4, Hybrid 6, etc. This hybrid which has a crop duration of 150-170 days with good ginning out-turn of 37.4% to 38.5%, was found suitable for spinning to 40s count.

Promising strains/Hybrids :

The following strains hybrids have shown promissing spinning performance.

State	*Promising strains/hybrids*
Punjab	LH.1134, LH.1445, LH.1031, LH.922, LH.944, LD.486, LD.451
Haryana	HS (CP).33, DS.5
Sriganganagar	RST.9, RST.19
New Delhi	Pusa.24, 45-3-4, 45-3-6, 16-14, 16-129, 16-131, 16-205
Madhya Pradesh	79.BH.5-3, JKHy.2, Sarvottam
Gujarat	G.4812, G(T) 538, G.84-909
Maharashtra	JLH.168, JLH.109, PH.93, LRK.516, NHH.302, NISD.3, MECH.4
Karnataka	LKK.516, NFDH.105
Andhra Pradesh	NHH.39, NA.1290, MCA.23, MCA.26, 1867, 1874
Tamil Nadu	TKH.4-3, HLS.321729, LK.861, TCH.1002, C.17

(c) *Research work on Agricultural and Technological Aspects Relevant to Cotton Improvement Work*

Technological Evaluation of Germ Plasm Material

In the course of execution of breeding programmes by the cotton workers, valuable genotic material used to be developed which might not have all the essential characters for release to the cultivators, but might have some character or combination of characters which would serve as a donor for future useful breeding work. Such genotypes were identified for the prominent character/s and the cultivars were registered and stored in the Germ Plasm (GP) bank for use by cotton workers while crossing, depending on the quality characters to be improved.

During January 1989 to March 1990 a total of 727 GP stocks were evaluated for main quality characters to identify and isolate proper cultivars with respect to quality character/s. 2.5% span length, 1/8″ gauge tenacity (g/t) and fibre fineness were determined on High Volume Tester and Maturity coefficient was determined by the spacer technique on Micronaire.

Fifty genotypes of *G. arboreum* collected from CICR, Nagpur, were evaluated for quality characters. 2.5% span length ranged from 21.1 mm (H.454) to 25.4 mm (H.435), Micronaire value between 4.4 (H..447 and H.461) and 6.9 (H.464) and the tenacity at 1/8″ gauge between 19.3 g/t and 31.2 g/t (AKH.4) There was good scope for the selection of donor as the variations in strength parameter was greater enough for cultures belonged to the medium staple group.

A group of 27 genotypes of *G. herbaceum* were collected and evaluated for quality parameters. The 2.5% span length varied from 19.6 mm (IA Cross I) to 25.9 mm (1744), Micronaire fineness from 2.5 (Seg. 22-3--2-87) to 5.3 (R 021) and tenacity at 1/8″ gauge between 19.1 g/t (IA Cross I) and 26.3 g/t (H.657). Genotype IA Cross I showed the lowest fibre length as well as least fibre strength.

About 100 exotic stocks were collected and evaluated for technological properties and the divergent characters were identified with each cultivar. Dominant quality characteristics also were recorded. A group of 20 GP stocks from Nagpur were evaluated for their technological performance and were identified for the prominent quality character/s. The culture DCI.128 had the lowest 2.5% span length of 220 mm whereas DCI.129 recorded span length of 26.0mm. Micronaire value ranged from 2.3 (DCI.128) to 4.0 (DCI.138). Tenacity at 1/8″ gauge was from 19.7 g/t (DCI.139) to 25.6 g/t (DCI.146). The cultivar DCI.128 which had the lowest span length also recorded lowest Micronaire value and low tenacity (20.8 g/t) at 1/8″ gauge. Genotype DCI.146 which showed the highest strength also possessed good span length (25.5 mm.).

About 530 *G. hirsutum* GP stocks from Haryana and Punjab states were newly acquired and analysed for the fibre quality. Out of these, 290 samples belonged to Punjab and 240 to Haryana (Hisar).

In Punjab stocks, 2.5% span length varied from 20.3 mm to 28.6 mm which

showed considerable variation in length showing good scope for the selection of donor. A few of them had good span length of above 26.0 mm. Micronaire value ranged between 2.4 and 4.1. Most of the stocks were poor in Micronaire value and had below 3.0 μg/in. Tenacity at 1/8″ gauge also was poor for most of the cultures and the tenacity ranged from 13.6 g/t to 26.0 g/t.

For the GP stock from Hisar, the 2.5% span length was from 15.4 mm to 30.2 mm, giving good scope for selection. Many cultivars had long staple with good strength and medium staple with poor strength.. Micronaire varied between 2.3 and 4.4, more of them having less than 3.0 μg/in. Tenacity at 1/8″ gauge was recorded between 16.1 g/t and 27.2 g/t; strength variation was good.

Study on the Evaluation of Spinnability of Cottons from Single Thread Strength of Microspun Yarns

Eleven small samples from Trade Varieties and Standard cottons were collected for microspinning of finer counts of 50s, 60s, 80s and 100s and spun into two suitable counts each (22 samples).

The remaining 40 yarn samples from last years' lot and 22 samples of current year have been tested for single thread strength parameters like breaking strength, tenacity, elongation and CV% of breaking strength on Uster single thread strength tester. Similarly, 20 corresponding full spinning yarn samples have also been tested for the above single thread strength parameters. In this way, spinning and testing of all the full and microspun samples are completed. The strength values for 50s, 60s and 16s counts are given in Table 7.

TABLE 7 : SINGLE THREAD STRENGTH VALUES OF MICROSPINNING AND FULLSPINNING SAMPLES

50s

Sl. No.	Variety	Microspinning			Fullspinning		
		Tex	Breaking strength (g)	Tenacity (g/t)	Tex	Breaking strength (g)	Tenacity (g/t)
1	2	3	4	5	6	7	8
1.	G.Cot.Hyb.6	12.0	178.4	14.9	11.5	173.3	15.1
2.	G.67	11.0	132.4	12.0	11.7	159.4	13.7
3.	Hybrid 4	10.5	140.0	13.3	12.0	166.4	13.9
4.	G.Cot.10	11.7	155.2	13.3	11.9	163.3	13.8
5.	B.1007	11.4	145.2	12.8	12.1	174.4	14.4
6.	Nimkar	10.7	126.7	11.8	12.4	155.2	12.5
7.	LRA.5166	11.9	165.2	14.0	11.9	170.4	14.3
8.	MCU.5	11.4	158.8	13.9	11.6	173.2	14.9

— Table 7 contd.

1	2	3	4	5	6	7	8
9.	D.Hy.286	10.8	155.4	14.4	11.7	175.3	15.0
10.	Laxmi	11.7	158.0	13.5	12.3	172.6	14.0
11.	H.4	10.7	152.4	14.2	12.3	188.3	15.3
12.	Deviraj	11.5	152.4	13.3	12.2	171.0	14.0
13.	H.6	11.5	162.0	14.1	12.6	194.0	15.4
14.	SRT.1	11.7	174.8	14.9	11.3	180.0	15.9
15.	SRA.5166	12.8	175.8	13.7	11.9	165.2	13.9
16.	Hybrid.4	12.0	173.6	14.5	11.8	167.2	14.2
17.	LRA.5166	12.1	183.2	15.1	12.1	170.0	14.0
18.	Hybrid 4	11.4	164.8	14.5	11.6	160.4	13.8

60s

1	2	3	4	5	6	7	8
1.	MCU.5	9.6	145.60	15.1	10.0	159.8	16.0
2.	DHy.286	8.9	108.8	12.3	9.8	128.4	13.1
3.	MCU.5	9.9	156.0	15.8	10.3	164.0	15.9
4.	HA	9.3	119.6	12.9	10.1	151.6	15.0
5.	Deviraj	10.7	121.6	11.3	9.7	132.1	13.6
6.	Hybrid 4	9.3	120.0	13.0	10.5	132.4	12.0

16s

1	2	3	4	5	6	7	8
1.	G.11	36.1	497.0	13.8	36.4	433.0	11.9
2.	Digvijay	39.2	449.0	11.5	36.0	416.0	11.3
3.	Digvijay	36.4	468.0	12.9	35.5	430.0	12.1
4.	Digvijay	36.4	436.0	12.0	36.7	450.0	12.2
5.	Virnar	34.1	426.0	12.5	37.4	488.0	13.0
6.	V.797	37.4	430.0	11.5	37.5	469.0	12.5
7.	Sanjay	36.4	469.0	12.9	37.3	530.0	14.2
8.	V.797	37.9	447.0	11.8	37.2	457.0	12.3

On the basis of the analysis of 140 samples it was observed that :

(1) single thread yarn tenacity values of microspun yarns are less than that of fullspinning samples. The average percentage difference between these two values for different count ranges is given in Table 8.

(2) for all the cottons, microspun yarn strength variation (CV%) is much higher than that of fullspinning yarn. This is mainly due to the fact that the laps are made with hand and hence may not be even, resulting in increased CV% for count.

The Ranges of yarn strength CV% and its mean values for different count ranges are given in Table 8. From the table it can be seen that overall mean yarn strength CV% for microspinning (15.80) is higher than that of fullspinning (11.90) which is also true for each count, separately.

The consolidated analysis of the entire data is being done and it will be included in the final report which will be submitted shortly.

Quality of Fibres from Plants Affected by the New Wilt

Thirty-five *hirsutum* cultures, which were susceptible to new wilt, were kept under observation. The seeds obtained from previously wilted plants were grown side by side with their normal seeds, to assess genetical effect even at an early stage of growth.

Since there were no drastic seasonal changes, there was no sign of wilting either at an early stage or in the later stages of plant growth. Due to even distribution of rain, there was good moisture level in the soil and therefore, even the plant grown from seeds of wilted plants did not show any sign of drying at any stage. This showed that wilting has not been a genetical phenomenon; but the agro-climatic conditions that prevailed during the growing period and at the boll formation stages, resulted in wilting.

TABLE 8 : PERCENTAGE DIFFERENCE BETWEEN MICROSPINNING AND FULLSPINNING FOR TENACITY (g/t) AND RANGE OF SINGLE THREAD STRENGTH CV%

Count	No. of Samples	% Difference of Tenacity between Micro and Full spinning	CV% of Single Thread Strength			
			Fullspinning		Microspinning	
			Range	Mean	Range	Mean
16s	8	5.70	10.2 — 13.0	11.80	11.7 — 18.3	14.40
20s	39	4.23	7.6 — 15.9	11.60	11.2 — 20.4	14.70
30s	36	5.68	7.5 — 18.0	12.50	11.6 — 28.2	16.70
40s	31	7.90	8.8 — 16.3	11.90	9.6 — 23.3	16.05
50s	15	5.60	9.7 — 14.5	11.60	12.4 — 21.0	16.00
			Mean	11.90		15.80

The lint collected during the earlier season was tested for major fibre parameters and the results confirmed the earlier observations, which were as follows :

1. The maturity of the wilt affected lint was very much poorer than that of healthy lint.
2. The fibres showed unusually low fineness values due to high immaturity in wilted lint.
3. The staple length and the strength were significantly less than those from their healthy counterpart.
4. The lint obtained from wilted plant was neppy and contains more motes.
5. The yield per plant and ginning percentage was also low in wilted plant.

Assessment of Fibre Quality Parameters by HVT and Their Influence on Spinnability of Cotton

A new constant for correcting strength values obtained from HVT and regression equations for predicting spinning potential using HVT parameters, were worked out. While comparing test data of cotton samples determined on HVT and conventional methods, it was observed that 2.5% SL and Micronaire values showed good agreement, whereas the strength values were not comparable for very coarse and fine cottons. The constant provided by SPINLAB for correcting strength values from HVT was found suitable for cottons with Micronaire values ranging from 3.5 to 4.5. Attempt was therefore, made to workout a new constant for Indian cottons, having Micronaire values ranging from 2.6 to 7.5. In this connection, 12 cottons comprising 9 calibration cottons and 3 Indian cottons having high, low and medium Micronaire (Mic) values were tested on both Stelometer and HVT and the results were analysed. The slope and off-set of strength — Mic constants were changed for correcting optical mass.

$$\text{Amt} = \frac{\text{Optical Amount}}{\text{Mic} \times 0.0905 + 0.6350} = \text{Old constant}$$

$$\text{Amt} = \frac{\text{Optical Amount}}{\text{Mic} \times 0.1650 + 0.3400} = \text{New constant}$$

Lea CSP values of 84 cottons (ranging from 1765 to 2563 for 20s to 100s) were correlated with the corresponding HVT fibre parameters, viz. 2.5% SL, UR, Mic and Strength. An unified index (FQI) using HVT data was formulated.

$$\text{FQI} = \text{SQR} \frac{2.5\%\ \text{SL} \times \text{UR} \times \text{Str}}{\text{Mic}}$$

and the same was related with CSP values. Based on the higher correlation values, two regression equations were arrived at.

$$\text{CSP} = 902 + 25.8(\text{L}) + 12.1(\text{UR}) - 85\ (\text{Mic}) + 8.6(\text{Str})$$

$$\text{CSP} = 1216.9833 + 9.0817\ (\text{FQI})$$

The predicted lea CSP values from these two equations were in close agreement with actual lea CSP.

where SQR = Square root
L = 2.5% span length (mm)
Mic = Micronaire value
UR = Uniformity Ratio (%)
Str = Tenacity (3.2 mm) g/t
FQI = Fibre Quality Index

Inheritance of Fibre Length in G. Hirsutum *Cottons*

Ten established varieties were sown in 1989. There were 24 crosses. During 1990, the lint material of 24 crosses and 10 parents will be sown and fibre properties will be tested.

Variations in the Ribbon Width of Fibre for desi hybrid cottons

The ribbon width of 108 samples (in microns) were measured with Projection Microscope at a magnification of about 500, taking into account the matured fibres. For each sample, about 100 fibres were measured and the coefficient of variation have been calculated.

THRUST AREA II : POST HARVEST TECHNOLOGY OF COTTON

Research into aspects of precleaning and ginning of *kapas* and further mechanical processing of ginned lint to yarns mainly form a major area of CTRL's activity. It would be evident that the full realisation of the quality of the cotton produced could be achieved only by proper post harvest technological operations. Therefore, several investigations were undertaken covering the various facets of post harvest operations.

Survey of Conditions of Ginning Factories in Madhya Pradesh, Karnataka and Andhra Pradesh

A ginning survey was planned and initiated to cover the states of Madhya Pradesh, Karnataka and Andhra Pradesh. In the first phase, the survey work of ginning factories in Madhya Pradesh has been completed with the active co-operation of the East India Cotton Association, Bombay. A report was published based on the findings of the survey and the main observations and recommendations were as follows :

1. The Platts single roller gins commissioned in a number of factories are very old and have outlived their lives, necessitating replacement, at least in stages, with modern double roller gins.
2. Maximum care needs to be exercised in the baling of ginned lint by following the recent BIS specifications especially with respect to length of hessian and quality of hoops. Ginning and pressing charges also can be suitably revised upwards, if necessary, so as to ensure proper packing of lint.
3. The storage facilities in the factories require substantial improvement. *Kapas* as well as processed bales should be stored on raised platforms under well ventilated sheds.
4. *Kapas* should be precleaned before ginning so as to remove extraneous matters like leaf bits, immature bolls, boll rinds, stones, sand, etc. and a premium may be levied on such precleaned *Kapas*.
5. Gin fitters and helpers should be trained in the proper operation of gins and their maintenance by making use of the facilities available at the CTRL Ginning Training Centre at Nagpur. If required, the Ginning and Pressing Factories Act can be suitably amended to ensure appointment of trained fitters.
6. It is highly essential to ensure that admixture of varieties as well as seeds, are not taking place during and after ginning.

The Survey in Karnataka was undertaken with the help of Director of Agriculture, Karnataka. The distribution and collection of 205 questionnaires was completed with the help of the Cotton Supervisors at the respective places. In all, 12 major cotton processing centres, and in particular 60 ginning and pressing factories, were visited for assessing their working and machinery conditions. The completed questionaires are being analysed.

As regards ginning survey planned for Andhra Pradesh, personal discussion was held with the Director of Industries, Hyderabad, mainly to streamline the mode of distribution and collection of completed questionnaires. This work will be taken up in the next season.

Design and Development of an Inclined Type Cotton Cleaner

During 1989-90, machine fabricators were contacted for taking up the fabrication work of the precleaning machine and finally the order was placed with a suitable party for the fabrication of the machine. The fabrication of various components, viz. cylindrical rollers, fan type beaters, arrangement of spikes on beaters, shafts, pulleys, three types of sieves, inclined frame, m.s. sheet covers and lattice was inspected at the initial stage itself. The precleaning machine was assembled and put into operation at the Ginning Training Centre, Nagpur. It was operated for a continuous run of 8 hours at no load. It was also tested for its through-put capacity. The machine was found suitable to feed 16 to 20 DR gin factory.

Three types of *kapas* samples, viz. H.4, LRA.5166 and DCH.32 were used for preliminary trials with three different types of sieves. Machine was operated at 450 rpm speed during all the trial runs. Samples of *kapas* were collected before and after precleaning operation. Table No. 9 shows the results of this study. As expected, more trash was removed with the largest 12mm x 12mm size sieve. Immature locks were also removed by sieve. Fibre properties are being evaluated.

TABLE 9 : TRASH REMOVAL BY PRECLEANING MACHINE DURING PRELIMINARY TRIAL RUN

Sieve size (mm)	DCH.32		LRA.5166		H.4	
	Wt. of kapas (Kg)	Wt. of trash (g)	Wt. of kapas (kg)	Wt. of trash (g)	Wt. of kapas (kg)	Wt. of trash (g)
6 × 6	19.7	68 (0.34%)	21.3	37.0 (0.18%)	10.0	33 (0.17%)
8 × 8	19.5	117 (0.60%)	28.5	70.0 (0.25%)	19.0	60 (0.32%)
12 × 12	17.0	290 (1.70%)	29.0	171.8 (0.59%)	19.0	98 (0.51%)

Impact of Different Ginning Methods on Seed Quality

This investigation was undertaken in collaboration with the Central Institute for Cotton Research. *Kapas* samples of AKH.4, G.27, SRT.1 and PKV.081 were harvested in four pickings. These samples were ginned on CTRL Lab. Model Gin, SR Gin, DR Gin and Saw Gin. They were also hand ginned, as control. Seed samples were tested for fuzz percentage, germination, shoot length, visual cracking and electrical conductivity. However, no definite trend was observed for fuzz percentages and visual cracking of seeds between treatments. Maximum germination percentage of seed was observed after first picking; the germination percent decreasing with later pickings in most of the cases. Electrical conductivity (EC) as influenced by different treatment is given in Table 10. In general, it was observed that the latter harvest showed increase in EC values for all the four types of *Kapas* and gins. This was probably due to immaturity of seed-coat and membranal disintegrity in latter pickings as the seed-coat became more permeable to leachate. The results obtained for EC were comparable with the results of germination percentage. Shoot length results of seed from various ginning treatments and pickings are given in Table 11. Seeds obtained after first and second picking were more vigourous as compared to seeds of third and fourth pickings.

Seeds of SRT.1, AKH.4, G.27 and PKV.081 were sown on CICR farm in the last week of June, 1989. Spacing of 60 cm was maintained between the rows and 30 cm between the plants in each row. Crop was raised under rain fed conditions. Two

TABLE 10 : ELECTRICAL CONDUCTIVITY (EC) IN MM HOS/CM AS INFLUENCED BY DIFFERENT TREATMENTS

	Pickings			
Variety	I	II	III	IV
AKH.4	0.243	0.276	0.295	0.386
G.27	0.216	0.216	0.274	0.477
SRT.1	0.326	0.350	0.364	0.460
PKV.081	0.425	0.418	0.439	0.499
Gin				
Lab Gin	0.239	0.241	0.260	0.303
SR Gin	0.350	0.359	0.407	0.594
DR Gin	0.318	0.363	0.363	0.499
Saw Gin	0.311	0.326	0.383	0.461
Hand Gin	0.293	0.386	0.303	0.420

TABLE 11 : SHOOT LENGTH (IN CM) AS INFLUENCED BY DIFFERENT TREATMENT

	Pickings			
Variety	I	II	III	IV
AKH.4	8.615	8.580	7.255	6.020
G.27	7.745	7.835	6.805	5.930
SRT.1	11.514	11.715	9.940	8.755
PKV.081	11.750	11.900	9.510	7.455
Gin				
Lab Gin	9.869	9.919	8.413	7.288
SR Gin	9.769	9.806	8.088	7.287
DR Gin	10.044	9.981	8.475	6.931
Saw Gin	9.825	10.200	8.356	6.881
Hand Gin	10.019	10.131	8.556	6.863

sprays of systemic insecticides, one each of Rogar and Metasystock for sucking pests, four sprays for bollworm control with Endosulphan, Decis, Neucron and Sumicidin in that order and two sprays for disease control, one each of copper sulphate plus streptomycin followed by wetable sulfur (80%) were sprayed on *Kapas* from all four varieties of cotton. Recommended cultural practices were adopted for raising the crop. *Kapas* samples were picked in four phases.

Incidence of Seed Coat Fragments in Ginned Cotton

For a detailed study on the incidence of seed-coat fragments in ginned cotton, about 12 samples of cotton were procured. These are Desi-89003, Desi RG-8, Maljari Wagad, LRA-5166, H.4, SRT.1, Laxmi, AHH.468, F.414, F-91272, JKHy.1 and Mech.9. In addition, attempts were made to obtain some other samples such as DCH.32, Suvin, Virnar, H.6, etc. Some preliminary experiments on the hand cleaned samples gave encouraging results. A lab. model gin has been procured recently and is being installed.

Contribution of Ring Frame Process Parameters to the Fault Levels of Yarn Spun from Indian Cottons

With a view to determine the effect of short fibre removal by combing on the quality of yarn and Uster Classimat faults Pima cotton was combed to three levels of comber noils, viz. 10%, 14% and 18u. 40s yarn was produced from the respective combed slivers during the previous year. During the reporting period, fibre length analysis of the combed slivers of different noil extraction, trash analysis using 'Essdiel' sliver trash analyser and seed coat estimation both by weighing method and counting method were carried out. Besides the above determinations, the yarn from various combinations were tested for yarn characteristics including classimat faults.

Table 12 gives the fibre and yarn properties and Uster Classimat results for different noil extractions. The major conclusions drawn were as follows :

a. Increasing the noil extraction from 10% to 18% results in an improvement of 50% span length and uniformity ratio. The increase was about 0.76% for 1% noil extraction.

b. There was substantial reduction in seed coat fragment and trash (about 4.3% by weight for 1% noil extraction).

c. A significant improvement in overall yarn characteristics was found upto 14% noil extraction but reduction in A,B and OBF (objectional faults) continues upto 18% noil extraction.

Anatomy of Yarn Faults, Their Source of Occurence and Mechanism of Formation

During the reporting period, a detailed study was undertaken to estimate the contribution of polyester denier in a blend of polyster-viscose blend towards the quality of yarn with special reference to the Classimat faults.

For this purpose, polyester fibres of 38 mm but of different deniers, viz. 1.2, 1.4 and 2.0 were blended separately with viscose staple of 38 mm cut-length and 1.2 denier in the proportion of 48:52 (polyester: viscose). The blending of fibres was carried

TABLE 12: EFFECT OF DIFFERENT COMBING EXTRACTIONS (PIMA COTTON)

Noil Extraction (%)	0 (Control Card sliver	10	14	18
Fibre Properties of Combed Slivers				
50% span length (mm)	16.86	18.07	18.31	19.20
U.R. (%)	46.90	50.60	51.80	53.40
F.F.I. (based on 12.5% S.L.)	22.70	21.00	20.80	19.70
Trash content (%)	0.27	0.15	0.09	0.06
Seed Coat Content				
(a) by weighing method (%)	0.148	0.051	0.040	0.032
(b) by counting method (Nos. per 10 gms)	58	25	21	16
Yarn Properties (40s count)				
Lea CSP (corrected)	2,652	2,840	2,976	3,012
Uster (%)	16.2	13.6	13.0	12.9
Thick places/KM	1,130	610	340	320
Neps/KM	1,980	1,800	800	890
Classimat Faults (Avg. per 100 km)				
All — A	16,760	9,384	5,087	365
All — B	1,363	491	372	215
All — C	359	140	149	149
All — D	68	33	34	38
OBF	432	144	138	74

out in the blow room. The laps produced were carded and the carded slivers were processed on high speed drawing so as to produce 0.18 hk. for rotor spinning and 0.20 hk. for ring spinning. Yarns (15s) were spun from various blends on a Rieter Spintrainer from 0.18 hk. finisher head draw frame sliver, keeping the processing parameters constant on O.E. for all the samples. The sliver meant for ring spinning was passed through high speed canfed inter. 15s yarns were produced on a ring frame equipped with pneumatic loading on top rollers. The yarns spun from various combinations were doubled using a twist of 80% as that of singles. Both single and doubled yarns from the various combinations were tested for tensile strength and other characteristics.

In addition, the faults have been segregated using Uster Classimat for both ring spun and rotor spun single yarns from

defferent denier polyester fibre. Representative fault boards of A,B,C and D classes and objectionable category were prepared and photographed.

The main findings are summarised below:

(A) (i) Rotor spun polyester-viscose blended single yarn suffers much in quality as compared to single yarn spun on ring frame. The strength difference between the two yarns is as high as 24% to 29%.

(ii) The yarns spun on rotor system is inferior in respect of evenness and elongation as compared to the yarns spun on ring frame.

(iii) As the polyester fibre denier becomes coarser, the realisation in quality of rotor spun single and doubled yarns improves as compared to the ring spun yarns.

(B) The following observations were made after analysing both ring and rotor yarn (single) for physical appearance of faults :

OBF and B, CAD faults in ring spun yarns : These are mostly coil like faults, wherein, some fibres are wrapped round the yarn body.

OBF in rotor spun yarns: Majority of faults are due to the accumulation of excess fibres in a spiral form on the body of the yarn. Some faults with 'waist Band' are also observed.

A. Faults : Unlike trash particles in cotton, these faults are occuring both in ring and rotor, due to fly collection.

B,C and D in rotor yarn : These are mostly slub type faults.

Optimal Blending of Standard Cotton Varieties of the Southern Region Comprising Andhra Pradesh, Karnataka and Tamil Nadu

Spinning of 170 CO2 (Code No. S. 10) was completed during the period. It was spun to 20s, 30s and 40s counts on the LR and SKF drafting systems. It was also spun to 20s on the Open end spinning machine for comparison with the same count of yarn spun on the ring spinning machine.

The selection of binary blends was made afterwards comprising Jayadhar and 170 CO2. The processing of these two blends were taken up and completed. On the ring frame they were spun to 20s and 30s counts on the LR and SKF drafting systems. They were also spun to 16s and 20s yarn on the Open-end spinning machine for comparison of yarn properties.

Fibre orientation studies for materials from short processing sequences as well as from long processing sequences for the remaining two cottons (Suyodhar and 170 CO2) and five blends (S.6, S.7, S.8, S.11 and S.12) were completed. Lea count and breaking strength of the remaining five samples (Code No. S.7, S.8, S.10, S.11 and S.12) were tested for corrected CSP calculations.

Blend S.6 having higher % of MCU.5 has given better yarn quality for all counts on both (LR and SKF) drafting systems.

With these studies the experimental and testing part of the project is over, while calculations and data analysis are in progress.

Comparison of Yarn Bundle Strength with Lea Strength

In connection with a study on comparison of yarn bundle strength with lea strength, two jaw attachments to the lea strength tester were fabricated to test parallelised yarn bundles. The jaws are made from mild steel and are chrome plated. Rubber lining is also provided to the jaws. Preliminary tests have shown that no slippage taken place during test.

THRUST AREA III : STRUCTURE, PROPERTY AND THEIR INTER — RELATIONSHIPS IN TEXTILE MATERIALS

The morphological and fine structural parameters of the cotton fibre collectively determine the physical and mechanical properties of not only the fibre but also the yarns and fabrics produced using the fibre. Therefore, a true understanding of structure-property relationships is highly essential especially for developing varieties adaptable to modern processing techniques using sophisticated machinery, by having a wide range of combinations of fibre quality, as also for determining processing sequence to manufacture end-products for different applications. This thrust area has, therefore, been one of the key areas of CTRL's activities and several investigations, including a few of fundamental nature, were undertaken covering various aspects.

Enzymolysis of Never Dried Cotton Cellulose and other Cellulosic Materials

At CTRL, studies were conducted in the past on the enzymolysis of never-dried cotton cellulose and the trend with regard to the specific glucose yield using the *arboreum* cotton, G.27, was reverse to those of cottons belonging to other species. In order to confirm this trend, the study was extended to two more varieties from the *arboreum* species, viz. Maljari and 1015. The same pattern was observed in these cases also.

The residues after enzymolysis from the above two varieties were subjected to X-ray examination for structural evaluation. The results are given in Table 13. As observed in the case of enzymolysis of G.27, both Maljari and 1015 also did not show any decrease in crystallinity during the course of enzymolysis. This perhaps points out to the peculiarity of *G. arboreum* cottons as compared to *G. hirsutum* and *G. barbadense*. It may be mentioned that the chain length distribution, a factor likely to influence enzymolysis, might be different in those cottons belonging to *G. arboreum* as compared to those of *G. hirsutum* and *G. barbadense*.

In order to find out the molecular weight distribution of some cottons, experiments were conducted by dissolving the cottons in cadoxen solvent. The strength of the cadoxen solvent was so adjusted that it will dissolve cellulose of around 10,000 molecular weight. The ratio between the residue and the precipitate was taken into account for comparison. The results are given in Table 14. It is clear from the data that the residue was less in all the cases during the early stages whereas, the glucose yield on enzymolysis was maximum in the case of 20 day old bolls in both Laxmi and Suvin cottons; but the trend was reverse in both *arboreum* and *herbaceum* cottons.

TABLE 13 : CHANGES IN THE REDUCING SUGARS AND CRYSTALLINITY DURING THE COURSE OF ENZYMOLYSIS OF NEVER-DRIED COTTONS

Time of Incubation	G.27				Maljari				1015			
	R.S	Glucose	Amorphus	$\beta\frac{1}{2}(200)$	R.S.	Glucose	Amorphus	$\beta\frac{1}{2}(200)$	R.S.	Glucose	Amorphus	$\beta\frac{1}{2}(200)$
Control	—	—	36	1.65	—	—	35	1.70	—	—	36	1.65
0h	1.5	—	35	1.70	1.13	—	34	1.75	1.4	—	36	1.75
15 min	9.2	0.9	34	1.73	9.50	0.93	33	1.65	9.2	1.1	37	1.75
30 min	17.6	2.6	38	1.75	18.70	2.80	36	1.55	19.4	3.2	36	1.80
1h	49.0	9.8	34	1.80	34.80	5.30	32	1.65	39.5	5.8	35	1.75
2h	72.2	15.9	37	1.80	55.20	9.30	36	1.75	68.0	16.0	36	1.75
3h	88.7	19.6	37	1.78	66.80	17.40	34	1.70	80.0	19.0	36	1.75

R.S = Reducing sugars

TABLE 14 : CHANGES IN THE SOLUBILITY OF DIFFERENT COTTONS IN CADOXEN SOLVENT

	SUVIN				LAXMI				G.27				V.797			
	20 day old		40 day old		20 day old		40 day old		40 day old		At Maturity		40 day old		At Maturity	
	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P
	36	64	66	34	64	36	27	73	58	42	70	30	10	90	61	39
Glucose yield after 3h of enzymolysis (mg/100 mg)	36.0		11.0		27.0		17.0		12.0		20.0		9.6		17.0	

R = Residue P = Precipitate

Lattice Conversion Behaviour of Cotton Fibres

For this study swelling treatments using CsOH solution were completed during the reporting penod. Five distinct regions of order were clearly brought out in the Lateral Order Distribution (LOD) Curve.

The comparison of the LOD Curve obtained using different swelling agents revealed that LiOH and CsOH are the most useful structural probes for cotton fibres. The former is useful for investigating regions of very high order and the latter for the study of low ordered regions in the fibre. Because of the critical range of concentrations of CsOH needed in such studies, and due to its high cost CsOH can be replaced by NaOH unless information on minute differences is of interest. Twelve cottons, chosen in such a way that they provided scope for interpretations in terms of maturity as well as genetic species, were treated in solutions of LiOH and CsOH having concentrations corresponding to the peaks observed in their respective LOD Curves. The samples were examined for lattice conversion by XRD methods. Although analysis of the results are yet to be completed, the trends indicating the changes observed in the different cottons cannot be interpreted either in terms of maturity or genetic factors individually. Both appear to be relevent to the context, their combined influence being difficult to understand.

Cotton Fibre Tensile Properties in Relation to the Morphological and Fine Structure

Twenty-five varieties of cotton drawn from all the four major botanical species were tested for a range of physical and structural properties. The former included linear density, breaking strength, tenacity, breaking extension, ribbon width, cross-sectional perimeter, cross-sectional area and circularity. Structural properties comprised convolution frequency, convolution angle, structural reversals and fibrillar orientation angle.

The main findings, based on analysis of the extensive data collected are briefly given below :

(i) The cross-sectional perimeter of fibre seems to be characteristic of each variety. This is shown by the low CV% of perimeter values for fibres in each variety. Ribbon width and cross-sectional area also can be largely regarded as varietal characteristics.

(ii) The packing density of fibrils in the cell walls of different varieties of cotton appears to be markedly different. This possibility is highlighted by the fact that the mean cell wall areas measured on fibre cross-sections show only poor correlation with the tex values for the varieties. If on the contrary, the material density remained constant, we should expect a one-to-one correspondence between the two quantities.

(iii) A high positive correlation between convolution angle and X-ray angle found among different varieties shows that fibrillar spirality is the cause of convolutions and that the direction of convolution is the same as that of the fibrillar spirals in each length segment of the fibre, flanking a structural reversal. At the reversal, both convolution and fibrillar strands reverse the direction of spirality.

(iv) Like most other properties of cotton fibre, the number of structural reversals too show variations among varieties as well as within each variety. In both cases, the reversal density is found to decrease with increasing fibre weight. Thus, coarse varieties as well as coarse fibres within each variety have fewer reversals per unit length.

(v) Coarse varieties have lower tenacity though the breaking load does not show any relation with linear density. Within each variety, fibre strength increases with linear density but later tends to level off. The tenacity increases with linear density, reaches a maximum and then falls off to very low levels. These results have served to confirm the universality of an earlier CTRL finding based on a few varieties of cotton that fibrils in the linear layers contribute relatively less to the load bearing capacity of the fibre and that this property follows from the more parallel orientation of the linear-fibrillar spirals with respect to the fibre axis.

A Study on Crystallisation of Cellulose

For a study on crystallisation of cellulose, crystallisation during growth was monitored by collecting fibres from bolls harvested everyday from the twentieth day after flowering. It was noted that the crystallinity improvement was very fast initially upto a period of 25 days. Thereafter, it remained nearly the same or registered a small decrease for the next few days. This second phase was followed by another period of fast increase before finally reaching saturation. Crystallite width showed an almost identical variation with age of the boll. Orientation too registered a fast initial increase and remained nearly steady during the second phase before starting to rise further. These results indicate the possibility of a poor order cellulose being deposited in the intermediate phase during wall development. In this experiment the fibres are from bolls collected from plants grown in pots, all of which did not flower on the same day.

In order to confirm the above results, it was felt necessary to repeat the entire experiment with fibres collected from bolls that flowered on the same day and coming from plants grown in adjacent rows in the field. Plants of the variety G.Cot.10 raised in Athwa farm, Surat were, therefore, selected for the purpose. About 500 flowers were tagged on the same day. A few bolls were harvested everyday from 18th day of flowering and were immediately transferred to aqueous formaldehyde (5%). Later, the bolls were washed in water and air-dried and fibres were separated by hand. Tenacity at 3.2 mm gauge length as well as % mature fibres were measured for all the samples collected till field opening of the boll. Percent mature fibres showed an almost steady increase with increase in age of boll upto 35 days and thereafter, showed a slow rise before tending to level off. Tensile test data showed a steady increase in the intrinsic fibre strength upto 25 days, thereafter it remained nearly steady upto about 37 days before showing a further rise in the week prior to field opening of the bolls. Thus, at least for the variety tested in the present study, there was a marked increase in tenacity during the last week of growth. (Field opening of the bolls occurred at 45th day). Tenacity data seem to suggest that the contribution to intrinsic strength

from the later deposited cellulose is more than that from the layers deposited at intermediate stages of growth.

Crystallinity measurements based on IR index III showed an intermediate growth period in which the deposited layers are of poorer crystalline order.

For establishing the effect of induced crystallisation on the variety and age of boll, a few more varieties of cotton harvested at two growth levels were dried slowly under optimum conditions. The crystallinity and orientation measurements confirmed the varietal response of the cottons for both the phenomenon. However, it was noted that the improvement in orientation by slow drying was remarkable when the maturity was poor, though this was not quite true in the case of crystallinity.

Study on Structure-Property Relations with LiOH and KOH Treated Cottons

Comparison of NaOH and KOH treated cotton fibres swollen at 45° revealed that the retention of tenacity at both zero and 3.2 mm gauge lengths is almost the same at concentrations above 4N, where sufficient swelling seems to have occured. The elongation was also found to be comparable in fibres treated in both the reagents. The amorphous content in NaOH treated fibres was however, lower than that for KOH, a fact observed earlier even in lower temperature treatments. On the other hand, swelling characterised in terms of water retention values was lower in KOH treated fibres. In order to compare the effects of LiOH, NaOH and KOH at various temperatures (15°C, 31°C and 45°C) a concentration of 4.5N was selected and the structure-property data were examined in detail on fibres treated in these reagents. The concentration of 4.5N was chosen with a view to ensure sufficient swelling in all the three reagents at all temperatures. Analysis of the results indicated that KOH treated fibres have higher tenacity, particularly at 3.2 mm gauge length, as compared to NaOH and LiOH treated fibres. The breaking elongation of KOH treated fibres is higher at lower temperatures and is comparable to NaOH treated fibres when swollen at 31°C and 45°C. In order to explain this mechanical behaviour, structural evaluations were carried out and it was found that KOH treated fibres possess higher amorphous fraction and also are better oriented. Although the swelling is marginally lower during KOH treatment, it appears to be optimum to help retention of mechanical properties. Higher amorphous fraction coupled with lower crystallite dimensions could make the fibrillar elements more flexible and enable them to realign in a better way during application of a tensile load. The realization of higher tenacity at all gauge lengths after KOH swelling would also be helped by the higher fibrillar orientation resulting from the treatment.

To evaluate the influence of strength uniformity and fineness of different varieties of cotton on KOH swelling, cottons differing in initial strength uniformity and fineness were chosen. These cottons numbering 21, drawn from 3 species, *G. barbadense*, *G. hirsutum* and *G. arboreum* were swollen at room temperature in 5N KOH. For comparison, the treatment was carried out in NaOH, as well. The mechanical properties of the swollen fibres were measured. Analysis of the results brought out the following salient features :

(1) In the case of cottons belonging to *G. barbadense*, higher the initial strength uniformity, the lesser is the increase in 3.2 mm gauge tenacity after swelling in both NaOH and KOH.

(2) In the case of more uniform varieties in *G. arboreum* species, the tenacity at 3.2 mm gauge length is found to decrease, after NaOH treatment. On the other hand, although the initial uniformity of the cotton did influence the KOH swelling, the tenacity at 3.2 mm gauge length was always higher than the corresponding controls even for the most uniform cotton chosen in the study.

(3) In the case of cottons belonging to *G. hirsutum*, the initial strength uniformity of the cotton was found to have very little influence on the tenacity at 3.2mm gauge length. In these cottons also, the tenacity after KOH treatment was always higher than that after NaOH treatment.

(4) The breaking elongation, in general, was marginally lower after KOH treatment as compared to NaOH, irrespective of the initial uniformity or species to which the cotton belonged.

The above study was extended to yarns as well. Yarns spun to different counts using cottons differing in fineness and strength uniformity were swollen in KOH and NaOH (5N, room temperature) and stretched back to original length. It was found that, in general, the tenacity of KOH treated yarns was always higher than the respective untreated controls, unlike in NaOH treatment.

Relaxation of Molecular Orientation in Stretched Fibres

During the year, fabrication of fibre rotator-cum-stretcher, to enable birefringence measurement in stretched fibres, has been completed. Dynamic birefringence was measured on stretched fibres of keratin, polyester and nylon. Some of the results were analysed and compared with stress relaxation data.

Measured birefringence in stretched keratin fibres show relaxation behaviour and at equilibrium, its value approaches close to that of the unstretched fibres. In these fibres, the structural transformation from coiled to extended B-form lead to increased molecular mobility and relaxation of birefringence originates largely from loss in the order and orientation in fibril phase. These results in principle agree with the relaxation data.

In the case of synthetic fibres, polyester fibres show increase in birefringence on stretching but do not show relaxation within the experimental time scale of a few hours. On the other hand, polyamide nylon fibres show relaxation but the magnitude was small.

Amongst the three fibre types tested, keratin fibres showed maximum relaxation of birefringence and also recovery, when allowed to retract to original length. The molecular mechanism for relaxation to occur has been related to generation of free volume.

Structure and Properties of Natural Cellulosic Fibres other than Cotton

For an investigation to assess the structure and properties of some natural cellulosic fibres other than cotton, a wide range of physical properties including (1) Tenacity (2) % Elongation (3) Tex (4) Moisture regain (5) Holocellulose content (6) Fibre density, and (7) Single cell diameter, were measured for a variety of natural fibres as listed below :

1. Leaf fibres :

Two varieties of sisal :

(1) Agave sisalana and
(2) Agave cantala

2. Bast fibres :

Four varieties of banana :

(a) Basrai
(b) Safed Valchi
(c) Padalse
(d) Nendran

3. Fruit fibres :

Three varieties of coconut coir :

(a) West Coast Tall
(b) Laccadives Ordinary
(c) Dwarf × Tall

From test data for the three different types of fibres, it was found that banana fibre has the maximum intrinsic fibre strength as a technical fibre being as high as 70 g/t for some varieties. Among the above listed fibres, banana is the least studied fibre and efforts are on for a detailed study of fibre properties including variations in strength and extensibility along the length of fibres, as well as variations among fibres from the outer, middle and inner sheath.

Study of morphological features of raw and delignified sisal fibres has been completed with Scanning Electron Microscope. A few interesting observations made on the morphology were as follows :

(1) The appearance of a regular scale-like pattern of single cells on the surface which partialy disappeared on delingnification. The periodicity of these scales seems to be much lower than the average single cell length. This difference suggests that the single cells are disposed with considerable overlap in the multicellular fibre assembly.

(2) Regular striations on the surface which do not disappear even after delignification.

(3) Fibrillar pattern on the surface under high magnification in the case of delignified fibres. Light microscopic observation of the single cells showed the tendency of fibres to twist (convolute) in a manner similar to that observed in cotton fibres.

Measurement of Frictional Characteristics of Cotton Fibre

An attachment to the Instron tensile tester which measures fibre fricion with respect to a standard plane surface has been fabricated. The test sample in the form of a parallelised bundle of fibres mounted on the face of *Specimen* holder is drawn along a horizontal platform called *the reference surface* and the force of friction

between the fibre bundle and this surface is measured with the help of the Instron tester.

The specimen holder is a block of plastic material machined to give an even surface (the face) on which a bundle of fibres of uniform thickness can be mounted with the help of a close-fitting frame which ensures that the fibres remain taut and do not get disturbed during measurement. The frame carries a hook to which one end of a fine string is attached. The string passes below a tiny pulley fixed to the platform and is linked to the load cell of the Instron such that while the crosshead carrying the load cell moves upwards, the sample holder is dragged along the platform. A sheet of desired 'reference surface' such as glass, metal, fabric or paper can be mounted on the platform so that the force of friction between the fibre tuft and any of these surfaces can be measured. This frictional force acts on the load cell of the Instron as the crosshead moves up and is recorded on the chart paper. The standardisation of the experimental technology is in progress.

SEM Studies on the Effect of NaOH Swelling Treatment on Morphological Deformities in Cotton Fibres

Trials on different procedures for SEM examination of morphological deformities in cotton fibres before and after alkali swelling have been carried out. An appropriate experimental method has been standardised whereby, the effect of swelling on the deformities could be examined on the very same fibre specimen.

Individual fibres taken from two varieties of standard cottons, viz. AK.235 and Jayadhar were mounted under taut condition on the SEM specimen stub using special adhesive tape and cut pieces of glass slides. In the initial trials, the fibres in the raw state were examined in the SEM for morphological deformities without the customary gold-palladium coating in order that during the subsequent swelling treatment, alkali penetration would not be inhibited. However, satisfactory micrographs could not be obtained from uncoated fibres because of rapid charging, though it was possible to discern the morphological features, visually.

In later trials, the fibres were given a thin coating (gold-palladium) by sputtering and then examined before and after swelling. It was interesting to see that metal coating did not hamper fibre swelling. This was confirmed by the rapid untwisting of the fibre seen through an optical microscope during treatment. Alkali penetration is understood to be taking place from the 'shadow' region which would not normally receive an adequate layer of metal ions. The swollen fibre specimens were washed in water, dried and again sputter-coated with gold-palladium.

Representative micrographs of morphological deformities in the fibre specimens before and after NaOH swelling treatment were recorded. SEM observations on these fibres indicated that nearly all the morphological deformities present in raw cotton fibres can be removed by NaOH swelling treatment given under taut condition. Some of the fibres having extreme S or Z edge twist or V-band get ruptured, damaging the fibre wall seriously, and such fibres are found to break during swelling action.

For further studies on morphological deformities, attempts are being made to develop a suitable experimental technique so that, individual fibres can be given swelling treatment under the known conditions of stretching force/load and then assess the response of deformities to swelling process.

Some Aspects of Electrical Properties of Cotton Fibres/Yarn

In this connection, a set up has been designed for the measurement of electrical conductivity of cotton fibres/yarns. The fabrication of 'Sample holder' as well as machining, cutting, grooving, boring and finishing of raw steel materials for cryostat were completed.

THRUST AREA IV : CHEMICAL PROCESSING AND FINISHING TREATMENTS

Chemical processing and finishing treatments are essential from the point of view of imparting desirable properties and aesthetic appeal to end-products from Mechanical Processing as yarns and fabrics. A number of investigations on the different facets of this key area were undertaken in the past and generated useful technologies to endow cotton materials with useful properties. During 1989-90, the work carried out in this thrust area, was as follows :

Evaluation of the Response of Resin Finishing Treatments on Decrystallised and Stabilised Cotton Yarn

Modification treatments and crosslinking were carried out on yarn as well as on fabric samples and the yarn samples were decrystallised with 20% NaOH under slack conditions and stretched to 103% of its original length. Partial acetylation reaction was carried out on the unwashed samples followed by washing with water. The modified sample was then crosslinked with the resin DMDHEU using five different concentrations of resin and various mechanical properties were evaluated.

The modification treatments were also carried out on desized and scoured cotton fabric. The treatments were carried out both under slack and stretched conditions. Decrystallisation was carried out with 20% NaOH solution. In order to carry out the treatments under stretched conditions the fabric was made in the form of a bag and then slipped over a rigid stainless steel frame. The open end was hand stitched. The entire frame was then immersed in the reactants for carrying out the reaction. The modified fabric samples were then crosslinked with 4% and 8% concentrations of DMDHEU. The various mechanical properties like strength, elongation, crease recovery angle, tearing strength and abrasion resistance were carried out using standard test methods. Nitrogen estimation of the treated fabric was done as a measure of resin uptake. The moisture regain of the treated fabrics were also determined.

An increase in the tenacity retention is observed in the 103% stretched-mercerised and crosslinked yarn samples as compared to the normal stretched samples. But unlike in the normal stretched samples the 103% stretched samples register a slight fall in the tenacity on partial acetylation.

In the case of fabric samples, the modification treatments show similar results as observed in the case of yarn samples under normal stretch conditions. The results show that the modification treatment involving

decrystallisation with 20% NaOH followed by partial acetylation without washing off the alkali produces a better cellulose matrix for further resin finishing treatments with considerable low strength loss and at the same time retaining the same level of crease recovery angle as that of conventionally treated samples.

Antisoiling Finishes to Cotton and Blended Fabrics

Antisoiling finishing was given to cotton : terene blended fabric (CTB) samples with pad-bath solution containing 10% DMDHEU, 2.0% Zinc nitrate, 1.5% Carboxymethyl cellulose, 0.1% wetting agent along with 2.0% softener. Five types of softeners differing in ionic nature were used in the finishing treatment. The five softeners used were : (1) nonionic, (2) anionic, (3) cationic, (4) wax emulsion type and (5) silicone base type. The padding was done on a laboratory padding mangle and the fabric was dried at 80°C for 5 min and cured at 160°C for 3 min, washed to remove unreacted chemicals and then air-dried.

The finished fabric samples were evaluated for various properties, viz. (1) percent add-on, (2) breaking strength, (3) wrinkle recovery angle (4) wash-fastness of antisoiling finish (5) degree of soiling and (6) degree of soil removal.

The results of finished and control fabric samples were compared. The following are the main conclusions drawn from the analysis of the data collected :

(1) Antisoiling treatment lowered the degree of soiling from 100% (for untreated control) to 69% for anionic softener treated fabric.

(2) Degree of soiling was highest for anionic softener treated fabric followed by silicon based (nonionic) softener treated fabric. Cationic softener treated fabric had minimum degree of soiling.

(3) Degree of soil removal was highest for cationic softener treated fabric and lowest for nonionic softener treated fabric. Untreated control fabric had very low degree of soil removal.

(4) Durability or washfastness of the finish was maximum for anionic softener treated fabric (35%) and minimum for nonionic softener treated fabric (17%). These observations were made after 10 washes.

(5) Marginal increase in crease recovery was observed in antisoil finished fabric.

(6) All the softeners improved crease recovery to the same extent.

(7) Treated fabric samples showed considerable improvement in breaking strength over untreated control.

Antibacterial Finishing of Cotton Fabrics

Preliminary antibacterial finishing treatments were given to cotton fabrics with 12% acetic acid, 12% hydrogen peroxide, 10% Zinc acetate, 1% softener and 0.1% wetting agent. The material : liquor ratio was 1:100 and the fabric samples were treated for 8 minutes. The treated samples were then dried at 100°C for 7 minutes and cured at various temperatures (120°C, 140°C and 160°C) and time intervals (3, 4, and 5 minutes) to ascertain the appropriate curing temperature and time to get maximum add-on. The add-on was found to be maximum at the curing temperature of 140°C for

4 minutes. After standardisation, finishing treatments were given using different concentrations of Zinc acetate (10%, 12% and 14%), 12% acetic acid, 12% hydrogen peroxide, 1% softener and 0.1% wetting agent. The samples were dried at 100°C for 7 minutes and cured at 140°C for 4 minutes. The cured samples were washed with water and a neutral detergent and then air dried. The add-on which varied from 3.7% to 5.2% was determined by difference in weight of fabrics.

To ascertain the durability of the finish, the treated fabric samples alongwith the control were subjected to a number of mild launderings. All the treated, laundered and untreated control samples were evaluated for properties like add-on%, strength retention percent, Zinc percent, peroxide percent and antibacterial performance by a modified quinn test method using S-*aureus* and K-Pneumoniae. All the treated and laundered samples except the untreated control recorded 100% antibacterial performance.

Pre-processing and Dyeing Behaviour of Rotor and Ring Spun Yarns

Rotor and ring spun yarns of 14s count and 4.5 TM were spun from Laxmi cotton. The yarns were dewaxed, seoured and bleached according to standard methods. A series of direct, vat and reactive dyes were used to observe differences in the dyeing behaviour on these samples.

Hank samples weighing 2g were used in all the cases and were dyed to lighter (0.5%) and deeper shades (2%) separately and together, i.e. (one ring yarn + one rotor yarn) in the same bath. Material to liquor ratio of 1:20 was used in all the cases. Visual comparison of the samples was made to assess the differences in dyeing behaviour of the two yarns. Standard procedures for dyeing were used in all the three cases. Salts were not used for exhaustion in the case of direct dyes.

Direct dyes used were Incomine green B, Fast orange, Skyblue 6BS, Benzopurpurine 4 B (Conc) and Turquoise blue GL. Visual comparison of dye uptake with some of the dyes was not satisfactory and trials were repeated using only the green, blue and orange dyes. It was observed that in the case of green dyes, brighter shades were obtained with ring yarns (RS) as compared to rotor yarns (OE), whereas, OE yarns dyed deeper with blue dyes. With orange dyes. OE yarns gave brighter shades in common bath whereas, RS appeared brighter in separate baths.

Vat dyes used were Indonon Jade green, Yellow GCN and Blue BC Ultra Conc. It was observed that OE yarns dyed deeper with all the three dyes. Sometimes the green and yellow shades did not show conspicuous differences in the dyeing behaviour of the yarns.

Four types of reactive dyes of both cold and hot brands were used for the study. They were Brill. red, Brill. rose, Brill. Yellow and Brill. orange (cold), Brill. orange RX, Golden yellow IRX, Navy blue Rx and Turquoise blue 2GX (hot brand). It was observed that, in general, OE yarns gave brighter shades than ring yarns, but in lighter shades, it was sometimes difficult to visually distinguish the two.

In general, OE yarns under similar conditions of dyeing gave deeper shades compared to ring yarns in the three classes of

dyes used. The performance of vat dyes was better than that of direct and reactive dyes. The performance of reactive dyes was intermediate between those of vat and direct dyes.

Effect of Laundering on Physical and Mechanical Properties of Apparel Fabrics

Experimets were conducted on three fabrics (cotton, polyester and polyester/cotton) to assess the effect of fabric quality on three different washing methods, viz. (1) Hand washing, (2) Launderometer and (3) Domestic washing machine, using two detergents, viz. surfmatic and key, separately. Control, wetted (once) and washed samples were tested for breaking strength, elongation, abrasion resistance and tear strength.

It was observed that the breaking strength was reduced for all the three fabrics on washing by all the three methods and by both the detergents. Elongation % increased for cotton, while, there was no definite trend for polyester and polyester/cotton blended fabrics. Abrasion resistance decreased significantly for cotton and polyester/cotton fabrics, whereas, for pure polyester fabric sample there was slight increase. There was significant decrease in tear strength in all the three fabrics due to washing treatment. Amongst the three methods, washing with domestic washing machine appears to be most severe followed by hand washing and the laundrometer washing, respectively. Between the two detergents, the changes in all the quality parameters were higher for surfmatic as compared to key.

Out of the above three fabrics, cotton and polyester/cotton fabrics were subjected to artificial soiling by Standard BIS method IS:5785-1976 and soiled fabrics were subjected to hand washing using surfmatic. The soiled and soil washed fabrics were being tested for various fabric properties.

THRUST AREA V : UTILISATION OF BY-PRODUCTS OF COTTON AND PROCESSING WASTES

Full utilisation of by-products generated during post harvest operation of *Kapas* would increase the returns to the cotton growers from cotton cultivation. Similarly, utilisation of processing wastes for various useful purposes not only yield extra returns in monetary terms but also solve their disposal problem. Therefore, utilisation of by-products and processing wastes was another key area in which sustained attention was given for research during the last one decade at CTRL.

Bioenrichment of Cottonseed Hulls and Preparation of Protein Hydrolysates from Cottonseed Meal

It has already been standardized that a temperature of 50°C is optimum for the preparation of protein hydrolysates from cottonseed meal for trypsin and pancreatin at their optimum pH of 7.5 and 8.5 respectively, at a substrate to liquid ratio of 1:4 for 2 hours. The recovery of the hydrolysed products, however, ranged from 40%--50% with a nitrogen percentage of 8.5--9.5. Experiments are underway to increase the recovery by various pretreatments.

The protein hydrolysate obtained from trypsin was evaluated during the year, based on the colony characteristics of some bacteria, *Escherichia coli, Bacillus megaterium, B. subtilis*-159 and *Staphylococcus*

aureus were included in the study. The hydrolysates were incorporated in the medium alongwith the commercial product on equal nitrogen basis. The colony characteristics indicated that the cotton seed meal hydrolysate was comparable with the commercial product except *E. coli* where, the size of the colonies were smaller. In the case of B. *subtilis*-159, the size was bigger.

In another study, the hydrolysates were incorporated in the Tendler's Non-Synthetic Medium (TNS) and B. *subtilis*-159 was grown for 48 hr in shake flasks. The results indicated that the amylase production was two and half times more as compared to that from commercial peptone, i.e. 50 units/ml as against 20 units/ml.

The cellulase production of *Penicillium funiculosum*-F_4 was also carried out in shake flasks on cottonseed meal hydrolysates. The composition of protein hydrolysates are given in Table 15 and the results on the cellulase activity are given in Table 16. It is evident that the cotton and fileter paper activities are higher in the case of cottonseed meal hydrolysates as compared to commercial product in all the treatment.

Fermentation Studies on the Production of Cellulase of Penicillium funciculosum

P. *funiculosum*(F_4) was tried out for the production of cellulase in 5 litre modular fermenter by growing the organism in 2 litre *Trichoderma viride* medium (TVM) for $3\frac{1}{2}$ days. A 1% cellulose powder served as carbon source and SAG 471, an antifoam agent was added at a concentration of 0.06%. A 1% inoculum, which was prepared by growing the organism for $3\frac{1}{2}$ days on a shaker in the same medium, was added into the fermenter. The air was passed at the rate of 1 to 1.5 lit/min and agitation was kept at about 280 rpm. The filter paper activity of the enzyme obtained was determined. The experiment was repeated 5 to 6 times. It was observed that the organism grows well in the fermenter and produced 800 μg — 1200 μg of reducing sugars per millilitre of the filtrate. The results indicated that the production of enzyme in the fermenter was equivalent to that produced in the 100 ml medium in the flask.

TABLE 15 : PROXIMATE ANALYSIS OF PROTEIN HYDROLYSATES FROM COTTONSEED MEAL

Percentage Composition	Cottonseed meal (control)	Protein Hydrolysates obtained from		
		Trypsin	Pancreatin	Papain
Moisture	8.4	2.6	4.5	4.0
Fat	1.7	—	—	—
Nitrogen	8.2	7.2	5.6	8.9
Ash	6.7	9.5	10.9	7.9
Crude fibre	4.7	—	—	—
pH	5.5	5.5	6.0	5.5
Gossypol	0.915	—	—	0.012

TABLE 16 : ACTIVITY OF CELLULOSE OF PROTEIN HYDROLYSATES OBTAINED FROM DIFFERENT SOURCES

Source	Filter paper Activity (μg/ml)	Cotton Activity (μg/ml)
Commercial product (meat hydrolysate) (enzyme)	625	1175
Cotton meal Hydrolysate (CSMH) (Papain)	880	1640
CSMH (Trypsin)	900	1850
CSMH (Pancreatin)	860	1640

In order to study the effect of incubation period on cellulase production, the organism was grown in 1.0 litre TVM. The filter paper activity and carboxymethyl cellulase (CM Case) activity were determined in the meduim at an interval of 24 hr. It was observed that the organism could produce maximum cellulase between 72 hr to 84 hr.

Studies on the effect of various carbon sources on the production of cellulase are in progress.

Thermal Stability of Cottonseed Oil

The study was carried out with fresh refined sample of cottonseed oil alongwith those of the ground nut and soybean oils. Their iodine value (I.V.), peroxide value (P.V.), anisidine value (A.V.), totex value and free fatty acids (FFA) were determined. About 15 g of cottonseed oil, taken in 100 ml beakers were heated at 180°C for varying periods from 1 to 8 hrs. Their iodine value, peroxide value, anisidine value, FFA and totax values were determined. Iodine value of the heated oil samples decreased with increase in heating time, while the anisidine and totax values increased. Peroxide values increased at certain intervals and decreased at other intervals. Increase in free fatty acids was marginal. All the oil samples showed loss in weight due to heating. However, no rancid smell was perceived even in the case of oil samples heated upto 8 to 12 hrs.

Work on the separation and characterization of the polymers formed during heating of the oil is in progress. U.V. and infra-red spectra of the heated oil samples showed changes compared to those of unheated oil sample.

Rancidity of Cotton Seed Oil

Another aspect studied on cottonseed oil was the property of rancidity and this study has been continuing for the last few years. During the year, a second commercial sample of refined cottonseed oil (Anand) was obtained. Portions of this oil were taken in separate plastic containers and kept at room temperature by adding (0.02%) antioxidants butylated hydroxyanisole (BHA), butylated hydroxyanisole (BHA), butylated, hydroxy toulene (BHT), tertiary butyl hydroquinone (TBHQ) Tacopherol, 10% til oil, 10% groundnut oil and 10% of soybean oil, separately. The oil samples were tested for peroride value (PV), anisidine value (AV) and free fatty acids (FFA) at regular intervals.

Peroxide value (PV) as well as anisidine value (AV) of the oil samples increased with the storage period. At the end of 3 months storage period, all the oil samples

except that added with TBHQ and til oil became rancid, as indicated by the smell and the peroxide value. Oil sample with TBHQ had a PV of 33.1 and that with til oil had a value of 40.71, while, the others had a PV ranging from 86.7 to 108.0. Cottonseed oil containing til oil became rancid at the end of fifth month while, that with TBHQ became rancid at the end of sixth month. Increase in free fatty acids was marginal in the case of all the samples. Similar results were obtained with earlier samples of refined cottonseed oils.

The results showed that, of the permitted antioxidants used, only TBHQ was able to prolong the shelf life of cottonseed oil by 2 to 3 months. It was also found that the shelf life of refined cottonseed oil can be increased by the addition of til oil.

Bleaching Treatments on the Linters of Pure Varieties

Linters are one of the main by-products of cotton found as fuzzy fibres on the seeds after ginning of the *kapas*. Linters are useful as a source of pure cellulose for various purposes. An investigation on the effect of bleaching treatments on the linters of pure varieties, which was taken up in 1986, has been completed during the year. In the previous year, 26 cottonseed samples had been delinted on the laboratory model delinter and further cleaned by passing through Shirley Analyser and then a small quantity of these linter samples was purified by kiering and bleaching. The remaining 12 linter samples of the following varieties, (1) SRT (2) Ageti (3) Digvijay (4) Virnar (5) A.51/9 (6) Desi (7) Bijainagar (8) Khandwa 2 (9) LRA.5166 (10) CJ.73 (11) G.Cot.12 and (12) A.H.H. 468 and two commercially available linter samples, viz. (1) MCU.5-1st cut and (2) Varalaxmi were mill run and were kiered during the year and all these 14 samples were then bleached employing the standardised two step process.

Three different instruments, viz. (1) Shimadzu Spectrophotometer, (2) High Volume Tester and (3) Photovolt Reflectometer, were employed to determine the degree of whiteness of the linter (in raw as well as kiered and bleached form). The degree of polymerisation (D.P.) of 11 linter samples (kiered as well as kiered and bleached) has been determined in Cuprammonium Hydroxide (CUAM) solvent.

Some New Approaches for Improving Particle Boards Prepared from Cotton Plant Stalks

In order to set up a continuous laboratory plant for the preparation of particle boards from cotton plant stalks, different firms were contacted, who are manufacturing size reduction equipments like chippers, pulverisers, flakers, etc. and mixers to convert cotton plant stalks into chip form and then mixing with the binder. Some trials were conducted at M/s. D. P. Pulverisor, Bombay, and the chipped material was studied for particle size proportion.

Effect of Proportion of Particle Size in Multilayered Boards : With a view to study the effect of proportion of particle size in three layered particle boards, boards were prepared by varying the percentages of coarser particles in the board from 100% to 50% keeping resin content and other parameters, viz. pressure, temperature and time, constant. The properties of the boards were studied. It was observed that the thickness

of the boards varied from 11.5 mm to 7.5 mm (50:50) and strength ranged from 133.5 to 240.9 kg/cm². The boards prepared with 60:40 (coarse:fine) proportion gave 168.7 kgs/cm² bending strength.

Low Density Boards for Insulation Purpose : Boards were pressed at 3 different pressures, keeping other parameters constant, to get boards of low density. Pressure of 20 kgs/cm² gave the board of required strength and density.

Keeping the pressure constant, different experiments were conducted to analyse (i) effect of particle size and (ii) effect of resin concentration during preparation of low density particle boards.

It was observed that at 20 kg/cm² pressure, particles of 4 to 6 mesh size and 4.6% of resin was found suitable for preparation of low density boards. The study on thermal conductivity and sound absorption properties are in progress.

Boards prepared with different binders

Trials were conducted to find out the suitability of Aerolite-CB which is a urea formaldehyde resin in powder form as a binder (3% to 13.5%) in particle board preparation. The resin is prepared by mixing the powder with catalyst, hardner and water in specific proportions.

The boards, thus prepared were tested for physical and mechanical properties. It was observed that the bending strength (MOR) increased from 75.0 kg/cm² to 190.0 kg/cm². Water absorption has decreased from 1% to 38% for 3% and 13.5% resin respectively. The boards with 8% binder gave the properties meeting with BIS specifications.

Boards Prepared from Lignocellulosic Material Other than Cotton Plant Stalk

Experiments were also conducted on the bagasse sample, an industrial waste of paper industry, to find out its utilisation in particle board preparation. Two samples, viz. coarse and fine, were studied for the mesh size percentage and were analysed as per standard methods for different chemical constitutents like hot water solubles, alcohols, enzyme extractives, lignin, hollocellulose and hemicellulose. It was observed that bagasse dust sample was rich in hollocellulose (74.1%), lignin (31.55%) and hemicellulose (49.6%).

The boards prepared using 5% to 15% resin (urea formaldehyde) as binder, gave bending strength increasing from 69.2 kg/cm² to 128.0 kg/cm² and water absorption decreased from 52.6% to 17.7% showing that it is also a suitable raw material for the manufacture of particle boards. As the materials is light in weight and rich in lignocelluloses, low density boards for insulation purposes also can be made using this raw material.

Hard Boards from Cotton Plant Stalks

With a view to explore the possibilities of making hardboards from cotton plant stalks, trials were conducted for standardising the conditions for preparation of thermomechanical pulp (TMP) and pressure cycle suitable for hardboard preparation.

Preparation of Thermomechanical Pulp

Oven dry (O.D) cotton stalk chips (900 g of about 1.5 to 2 cm size) were soaked in

water for 30 minutes (upto approximately 50% moisture content). The soaked material was fed in a defibrator for defibration under 13 kg/cm² steam pressure for different periods of time ranging from 1 to 3 min. The steam was cut off and the materials was further defibrated with the existing steam for a period of one minute. The steam was then released from the defibrator and the material was taken out. The cooked material was further refined in a raffinator in single pass at 5% consistency. The pulps thus produced, were analysed for various properties like degree of freeness, drainage time, matt formation, etc. Results indicated that good quality TMP can be prepared by adhering to the following conditions :

— Steaming and Defibration : One min.
— Defibration with trapped steam : One min.
— Raffinating in one pass at 5% consistency.

Standardisation of Pressure Cycle : The mat of the thermomechanical pulps prepared on the above conditions was pressed in a cold press initially to remove the excess water and then pressed between the heated platens of a hydraulic press employing a three step pressure cycle. The first step involves dewatering of the pulp wherein the mat is pressed under a pressure of 200 kg/cm² and at 170°C for one minute followed by 2nd step involving release of the trapped steam, wherein, the pressure is brought down gradually to a level of 50 kg/cm² for ½ min. The third step involves hardboard preparation where in, the mat was pressed under 100 kg/cm² pressure for different periods of time ranging from 3 to 5 min.

From the various trials it was confirmed that good quality hardboards can be prepared by adopting the following pressure cycle.

I Step : 200 kg/cm² pressure at 170°C for one min.

II Step : 50 kg/cm² pressure at 170°C for ½ min.

III Step : 100 kg/cm² pressure at 170°C for five min.

The boards are being analysed for various strength properties.

Economic Feasibility and Standardisation of Preparation of Pulp and Paper from Cotton Plant Stalks

Economic feasibility and standardisation study for preparation of pulp and various grades of paper from cotton plant stalks was undertaken as the trials for the development of the processes for preparation of writing, wrapping, printing and kraft papers on a Laboratory scale proved successful. As the facility for carrying out pilot plant trials is not available at this laboratory, various research organisations like Forest Research Institute, Dehradun, Central Pulp and Paper Research Institute, Saharanpur and industrial units like M/s. Ellora Paper Mills Ltd., Tumsar and M/s. Nath Pulp and Paper Mills Ltd., Aurangabad were contacted and they have agreed to provide facilities for carrying out the above trial.

It was decided to undertake the trial at M/s. Ellora Paper Mills Ltd., Tumsar, as the factory was close to Nagpur, where, the arrangement for collection of cotton stalk was already made.

Pilot Plant Trial : Soda Pulping : About 3 tonnes of cotton stalk chips were digested in a rotary digester with 15% NaOH as Na_2O oven dry (O.D.) weight of the raw material at 165°C with a material to liquor rato of 1:3 for 3½ hrs. which included one hour time required to raise the temperature of the contents from room temperature to the cooking temperature of 165°C. The cooked material was washed thoroughly in a valley beater till it was free from black liquor and then beaten to get the pulp of desired freeness-250 CSF.

Bleaching : Since the quantity of the prepared pulp was not sufficient, it was not possible to bleach the same on the regular bleaching plant of the mills. Therefore, it was decided to carry out the bleaching in the beater itself.

The pulp was bleached using 7% available chlorine by a single step hypochlorite process at 5% consistency and 8.5 pH for two hours. The pulp was then washed thoroughly till it was free from chlorine and then the brightness of the pulp was measured.

Paper Making : The bleached pulp was then transferred to a chest, where different additives like rosin, alum, brightner, etc. were added and thoroughly mixed with the pulp to form the stock. The stock was then fed to the regular paper plant and paper of 60±1 gsm was prepared. The quality of the paper is being analysed. The economic feasibility of the above process is also being worked out.

Trials to Prepare Newsprint Grade Paper

With a view to prepare newsprint grade paper from cotton stalks, trials were undertaken to prepare thermomechanical pulp. The pulp was prepared by difibrating the cotton stalk chips in a defibrator under 16 kg/cm² pressure for five minutes followed by refining the material in a disc refiner in two pass at 5% consistency. The material was then beaten in a valley beater to get the pulp of desired freeness.

Standard paper sheets of 47±1 gsm were prepared and were tested for various properties like bulk density, breaking length, burst factor, tear factor, number of double folds, opacity, etc. Results indicated that the quality of the paper produced was not satisfactory and certain modifications were necessary in the pulping process.

Linseed Stalk for Fibre Extraction and Preparation of Pulp and Paper

Utilisation of Linseed Stalk for fibre extraction and pulping for papermaking was examined during the year. Stalks from the double purpose variety of linseed *"Gaurav"*, collected from the C.S.A. University of Agriculture and Technology, Kanpur were analysed for various constituents like, lignin, ash, hot water solubles, alcohol-benzene solubles, holocellulose, etc. The project was initiated mainly to utilise the waste generated after fibre extraction for pulp and paper making, as use of whole linseed stalk for pulp and paper with-out fibre extraction would not be worthwhile (since valuable fibre would go into pulp, for which such good fibres are not necessary). In the first phase of retting experiments utilising the micro flora pre-

sent in the dried stalk, retting trials were conducted in water for periods ranging from two days to twenty-one days. The retted stalk after drying were scutched in a laboratory model scutching machine to separate out the fibre strands from the vegetative woody portions. Various parameters such as yield of fibres, fibre strength, elongation, fineness, etc. were measured. Another set of retting trials to study the effect of material to liquor ratio and the pH of the medium on the quality of fibres were also conducted.

The woody portions separated during the fibre extraction process were collected. The analysis and the pulping studies are in progress with the above material. The overall results of the experiment carried out so far indicated that the quality of fibres in terms of yield, length and strength are satisfactory. The fibres are coarser and by optimising the time of harvesting and proper selection of scutchers, the fineness could be improved.

Preparation of Pulp for Various End Uses from Cotton Stalks and Other Post-Harvest Lignocellulosic Materials, via Anaerobic Digestion

Linseed stalks were processed through anaerobic digestion for different concentrations of Sodium hydroxide. The biologically digested materials were mechanically converted into pulp and then bleached with 1% Sodium chlorite at 70°C for 120 min (substrate to liquid ratio, 1:20). The bleached pulps were washed thoroughly and then beaten in a valley beater to get the desired freeness. Standard paper sheets of 60±1 gsm were prepared. The properties are being studied.

THRUST AREA VI : ORIGIN OF COTTON DUSTS AND ITS CONTROL

Cotton Plant Materials and Cotton Dust

With a view to effectively control the cotton dust in the processing areas for creating healthier work environment and also to enhance machine life by prevention of corrosion caused by the presence of dust, an investigation had been under way mainly to study the origin and composition of cotton processing dusts. As the first step, determination of elemental composition of various cotton plant parts was taken up using X-ray fluroscence spectrometer and over 25 elements were mapped out last year as well as during the year. 75% of the qualitative scans of the different plant samples taken up for the study was recorded.

Simultaneously, another investigation also was taken up for screening cotton plant parts for the presence of gram negative bacteria which could be a source of endotoxins that cause respiratory disorders in mill workers.

Characterization of Various Cotton Plant Parts for Microflora in Relation to Elemental Composition

The specific encouragement of *Bijerinckia* sp. on various parts of cotton plant of glanded varieties belonging to all the four cultivated species of cotton has been established earlier. Even in glandless varieties, the presence of *Bijerinckia* sp. on leaves is not ruled out, though less in number. However, bracts from such varieties did not show up these bacteria. This finding is interesting, since bracts comprise major portion of the cotton dust and study needs to be carried out on a number of varieties to establish this finding.

A couple of varieties from three wild species of cotton, varying in gossypol content in the leaves, were subjected to elemental analysis on X-ray fluorescence spectroscopy. Preliminary studies have indicated that samples containing high gossypol have low silicon and aluminium contents. Systematic studies in this direction are underway to establish the relationship between the microbial load, gossypol and elemental composition.

RESEARCH WORK DONE AT THE REGIONAL QUALITY EVALUATION UNITS

Akola : Effect of insecticidal treatments at various pest population levels on the physical properties on cotton variety AHH.468 was studed for 1987 and 1988 seasons. Though there was no effect on the fibre-length, the bundle strength was better in treatments where percentage of infestation was lower (i.e. 2.5, 5.0 and 7.5% infestation).

Effect of micro-nutrients on yield and quality of rainfed cotton variety AHH.468 was also studied and it was observed that various micro-nutrients and their combination along with the major nutrients like N and P through Urea and diammonium phosphate had no effect either on seed cotton yield or on the fibre quality characters.

Coimbatore : Effect of pink bollworm on fibre properties of MCU.7, MCU.9 and MCU.11 was carried out and found that except for MCU.11, the fibre length, maturity and bundle strength were significantly affected. However, the variety MCU.11 showed some resistance to pink bollworm attack and hence, fibre quality did not show much deterioration.

Dharwad : In an investigation, four *barbadense* cottons, viz. BCS 9-70 × TCS.30-6, BCS.9-70 × TCS.9-5, BCS.9-70 × TCS.3-5 and BCS.9-70 × BCS.171-2B were found best suited both for the exploitation of heterosis for seed cotton yield as well as for main fibre qualiy characters giving equal or superior fibre quality characteristics than the control, Suvin.

Guntur : Studies on bio-eficacy of newer insecticides against bolloworn were taken up on the variety MCU.5 with eleven treatments. Triazophos 100g/ha (ai/ha) has given the best results.

Hisar : Effect of fumigant on the quality of cotton H.777, with Aluminium phosphide at different depths (top, centre & bottom) was carried out. It was observed that Micronaire value and bundle strength were slightly low as compared to control (no treatment) when fumigat was kept at top & centre of the container. As expected there was no effect on 2.5% span length and maturity coefficient.

Effect of different levels of infestation (1, 2, 3 or 4 loculi damage) of pink bolloworm on the quality of cotton varieties H.777 and G.27 was studied. Quality of lint from infested loculi was poorer as compared to healthy loculi of the same boll.

Rahuri : Effect of sowing dates on yield and fibre properties of cotton varieties under summer conditions was studied with different dates of sowings. Fibre length, Micronaire value and maturity of the fibres were reduced with delay in sowing.

3

Publications

A. Annual Report

Annual Report of the Cotton Technological Research Laboratory for the calendar year 1988.

B. Research Publications (CTRL Publications — New Series)

404 S. N. Nagwekar, S. D. Pai, A. S. Mehla and B.P.S. Lather — Effect of Removal of Bracts on Boll Weight, Seed Cotton Yield and Fibre Quality in North Indian Cottons (Reprinted from Haryana Agricultural University Journal of Research, Vol. XVIII, No. 3, p. 215, September 1988).

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406 N. C. Vizia — A Note on Ginning Percentage Indicating Device (Reprinted from the Journal of the Indian Society for Cotton Improvement, Vol. XIII, No. 1, p. 72, March, 1988).

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408 Charulata R. Raje and Radhika P. Bhat — Cross-Linking of Cotton Cellulose with Glyoxal (Reprinted from the Indian Textile Journal, Vol. 99, No. 3, p. 84, December, 1988).

409 S. G. Vinzanekar, A. G. Jogdev, B. Srinathan, M. S. Parthasarathy and V. Sundaram — A Study of Rotor-spun Doubled Yarns (Reprinted from the Indian Journal of Textile Research, Vol. 13, p. 58, June, 1988).

410 J. K. S. Warrier and V. G. Munshi — Instron/Stelometer : Comparison of Correction Methods (Reprinted from the Indian Textile Journal, Vol. 99, No. 2, p. 174, November, 1988).

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Usefulness in Cotton Quality Improvement Research (Reprinted from the Journal of the Indian Society for Cotton Improvement, Vol. XIII, No. 2, p. 129, September, 1988).

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415 G. Viswanathan, V. G. Munshi and A. V. Ukidve — Variation in Hairiness Results of Cotton Yarns (Reprinted from the Indian Textile Journal, Vol. 99, No. 5, p. 42, February, 1989).

416 Jatin Vaidya, I. G. Bhatt and V. Sundaram — Dermatological Effects of New FR Treatment (Reprinted from the Indian Textile Journal, Vol. 98, No. 9, p. 52, June, 1988).

417 S. K. Chattopadhyay, B. Srinathan and M. S. Parthasarathy — Some Studies on the Short Range Thick Yarn Faults Estimated by Uster Classimat (Reprinted from Resume, of the papers : Thirtieth Technological Conference Sponsored by ATIRA, BTRA, NITRA and SITRA held at ATIRA, Ahmedabad in February, 1989).

418 A. J. Shaikh and V. Sundaram — Corrugated Boxes from Cotton Stalks (Reprinted from Indian Farming, Vol. XXXVIII, No. 6, p. 36, September, 1988).

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Ratio, Stiffness and Toughness of Cotton Fibres (Reprinted from the Journal of the Indian Society for Cotton Improvement, Vol. XIV, No. 1, p. 80, March, 1989).

425 R. H. Balasubramanya and V. G. Khandeparkar — Edible Mushroom Crop on Spent Cotton Stalks (Reprinted from the Journal of the Indian Society for Cotton Improvement, Vol. XIV, No. 1, p. 85, March, 1989).

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430 R. H. Balasubramanya, V. G. Khandeparkar and V. Sundaram — Large-Scale Digestion of Willow-dust in Batch Digesters (Reprinted from Biological Wastes, Vol. 25, No. 1, p. 25, 1988).

431 R. P. Nachane, G. F. S. Hussain, G. S. Patel and K. R. Krishna Iyer — A Study of Inverse Relaxation in Some Textile Fibres (Reprinted from the Journal of Applied Polymer Science, Vol. 38, p. 21, 1989).

432 G. S. Rajaraman, D. G. Shete and D. V. Mhadgut — A Technical Survey of the Conditions of the Cotton ginning and Pressing Factories in Punjab, Haryana and Rajasthan (Reprinted from the proceedings of National Seminar on Ginning held at Bhatinda (Punjab) on 9-12-1979).

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C. Other Publications

1. N. Thejappa and I. G. Bhatt — Nutritional Aspects of Cotton Seed Oil (Published in news letter of All India Cottonseed Crushers' Association — January, 1989).

2. V. Iyer, P. V. Varadarajan, K. H. Sawakhande and N. D. Nachane — Water Absorption Characteristics of Absorbent Polymer Prepared by Gamma Irradiation (Published in the Journal of Cotton Research and Development, Vol. 3, No. 2, p. 215, July, 1989).

3. C. R. Raje — Silicone-based Softener Yields High Crease-recovery (Published in the Indian Textile Journal, Vol. 99, No. 12, p. 124, September, 1989).

4. S. Venkatakrishnan and V. G. Munshi — Recent Developments in Colour Measurement and its Importance in Textile Industry (Published in the Indian Textile Journal, Vol. 100, No. 1, p. 346, October, 1989).

5. M. S. Parthasarathy and V. Sundaram — Modern Cotton Spinning Technologies in the Context of Indian Conditions (Published in the Indian Textile Journal, Vol. 100, No. 1, p. 124, October, 1989).

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10. G. F. S. Hussain, R. P. Nachane, K. R. Krishna Iyer and B. Srinathan-Weak-Link Effect on Tensile Properties of Cotton Yarns (Published in the Textile Research Journal, Vol. 60, No. 2, p. 69, February, 1990).

11. H. T. Lokhande, A. M. Thakare, N. B. Patil, P. K Chidambareswaran and J. K. S. Warrier — Formation of Ethylenediamine-Cellulose Complexes by Vapor-Phase Treatment (Published in the Journal of Polymer Science : Part C : Polymer Letters, Vol. 28, p. 21, 1990).

12. S. Mukundan, K. V. Janardhanam, B. M. Reddy and A. S. Reddy — Effect of Nitrogen and Phosphorus on Fibre Quality of Cotton (Published in the

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D. Papers presented at Seminars/ Conferences/Symposia

1. G. R. Anap and M. S. Parthasarathy — Comparative Performance of Single Roller, Double Roller and Saw Gins on Different Types of *Kapas* (Presented at 25th Annual Convention of Indian Society of Agricultural Engineering held at Udaipur from 5th January to 7th January, 1989).

2. S. K. Chattopadhyay, B. Srinathan and M. S. Parthasarathy — Some Studies on the Short Range Thick Yarn Faults Estimated by Uster Classimat (Presented at the 30th Joint Technological Conference held at the Ahmedabad Textile Industrys' Research Association, Ahmedabad from 3rd to 4th February, 1989).

3. Indira Iyer and V. G. Munshi — Critical Analysis of Tenacity Measurements on HVT System (Presented at the 30th Joint Technological Conference held at the Ahmedabad Textile Industry's Research Association, Ahmedabad from 3rd February to 4th February, 1989).

4. R. H. Balasubramanya, A. J. Shaikh, Yojana D. Pai and V. G. Khandeparkar — Preparation of Pulp from Mushroom-Raised-Spent-Cotton Stalks After Processing Through Anaerobic Digestion (Presented in the 29th Annual Conference of Association of Microbiologists of India held at Hisar from 9th February to 11th February, 1989).

5. S. G. Gayal and V. G. Khandeparkar — Amylase from *Bacillus subtilis* — 159 and Application of the Enzyme (Presented in the 29th Annual Conference of Association of Microbiologists of India held at Hisar from 9th February to 11th February, 1989).

6. V. K. Madan — Effect of New Promising Insecticides on Bollworm Incidence, Yield and Quality of Cotton (Presented in the National Seminar on Futuristic Approaches for Cotton held at Hisar from 24th February to 25th February, 1989).

7. G. R. Anap — Modernisation of Ginning Industry (Presented in the Seminar on Modernisation of Ginning Industry held at Karnataka Chamber of Commerce on 20th January, 1990).

8. G. R. Anap — Studies on Indian Lint Bale Pressing Industry (Presented in the XXVI Annual Convention of Indian Society of Agricultural Engineers held at Hisar from 7th February to 9th February, 1990).

9. P. K. Chidambareswaran and J. K. S. Warrier — Quick, Accurate and *In Situ* Linter Content Estimation (Presented at the 31st Joint Technological Conference held at Northern India Textile Research Association, Ghaziabad from 16th February to 17th February, 1990).

E. Technological Circulars on Trade Varieties of Indian Cottons

T. C. No.	Variety	Place
2423	Hybrid 6	Vadodara
2424	CJ.73 (Sanjay)	Bhavnagar
2425	SRT.1	Bhavnagar
2426	Deviraj	Surendranagar
2427	Hybrid 4	Surat
2428	Hybrid 7	Bayad
2429	F.414	Abohar
2430	Wagad	Surendranagar
2431	J.34 (S/G)	Rampuraful
2432	J.34 (R/G)	Raman
2433	1007	Khandwa
2434	(A) LRA.5166	Rajapalayam
2435	(B) LRA.5166	Rajapalayam
2436	AHH.468	Purna
2437	F.414 (S/G)	Kotkapura
2438	MECH.1	Guntur
2439	Sankar 4	Kadi
2440	Hybrid 4	Wani
2441	MCU.5	Guntur
2442	DCH.32	Gadag
2443	DCH.32	Nardana
2444	Y.1	Nardana
2445	Jayadhar	Hubli
2446	Sharada	Saundatti
2447	Gujarat 11	Kawari
2448	Desi RG.8	Sriganganagar
2449	Sankar 4	Khargone
2450	Maljari	Khargone
2451	Suvin	Coimbatore
2452	DCH.32	Coimbatore
2453	MCU.5	Coimbatore
2454	Jayalaxmi	Saundatti
2455	Jayadhar	Hubli
2456	F.414	Fazilka
2457	Ganganagar Ageti	Sriganganagar
2458	Digvijay	Kapadvanj
2459	DCH.32	Bellary

(Total 37 TV Reports)

F. Technological Circulars on Standard Cottons

S. C. No.	Variety	Place
341	Ganganagar Ageti	Sriganganagar
342	Deviraj	Junagadh
343	G.Cot.10	Surat
344	Hybrid 4	Surat
345	Hybrid 6	Surat
346	Sanjay	Amreli
347	Hybrid 4	Surat
348	Deviraj	Junagadh
349	Bikaneri Narma	Sriganganagar
350	RG.8	Sriganganagar
351	G.Cot.11	Surat
352	V.797	Chharodi
353	Maljari	Khargone
354	DHy.286	Rambhapur
355	AKH.4	Rambhapur
356	Hybrid G.Cot.6	Surat
357	G.Cot.10	Surat
358	G.Cot.11	Surat
359	SRT.1	Surat
360	Digvijay	Bharuch
361	AKH.4	Akola
362	V.797	Chharodi

22 Standard Samples

4

Extension

CTRL has no agricultural farm attached to it and therefore, no direct linkages are established with the farming community. However, indirect assistance to the farming community is rendered by way of development of useful equipments for field experiments as also through discussions/suggestions/advices on the technological aspects at every stage of crop development and post-harvest technology practices. Close collaboration is maintained with all major cotton breeding centres under the various state Agricultural Universities and Other Institutes under ICAR. The Scientists and Technical Officers, who are in-charge of the Regional Quality Evaluation Units of CTRL established in different cotton growing tracts in the country, function in close collaboration with cotton specialists and cotton scientists in the Agricultural Universities and state Departments of Agriculture. They actively associate themselves with the research programmers related to cotton being conducted by the Agricultural Universities as well as state Agricultural Departments in the region for tackling the problems of the Agricultural Community.

The Director and some of the Senior Scientists are members of several committees constituted by the Bureau of Indian Standards for standardisation of test methods for cotton and textiles, preparation of specifications for various cotton products, etc., in which the knowledge and expertise available at CTRL are fully utilised. Similarly, Director and few senior scientists are actively associated with many research advisory panels of other institutions. The Scientists and Technical Officers regularly participated in various conferences/symposia by presenting papers based on research findings and thus, disseminate expertise and information to user groups.

CTRL conducts training courses in Cotton Technology, mainly on cotton quality evaluation aspects of cotton fibres, yarns and fabrics as well as statistical methods connected with quality parameters. With a view mainly to strengthen the training activity, a separate training unit was created in the Quality Evaluation Division, which looks after, apart from training, such activities as supply of data for bringing out the technological circulars and Technological Reports on Trade Varieties and Standard Indian Cottons, providing consultancy services, conducting visitors to various divisions and overall supervision of the activities of Regional Quality Evaluation Units. The CTRL Ginning Training Centre at Nagpur conducts training in quality ginning for sponsored personnel from ginning factories all over the country.

EXTENSION

The nature of extension work being undertaken at present is mainly confined to supply of reliable and accurate data on the quality aspects of cotton, yarn and fabrics, reply to queries of technical nature, consultancy services, publication of research results for the benefit of user group, etc.

Technical Queries : Several queries have been replied during the year on cotton testing, utilisation of by-products, new products and processes developed, etc. In addition, problems faced by textile technicians during cotton processing were discussed in depth with the technicians and possible solutions given to them by the senior scientists of CTRL.

Paid Tests : CTRL has been receiving a fairly large number of samples of fibres, yarn and fabrics for paid tests from textile mills, government and semi-government organisations as well as cotton trade and industry on payment of prescribed test fees. The demand for testing on High Volume Instruments (HVI) has considerably increased and the clientele included M/s Cotton Corporation of India, various state Co-operative Cotton Marketing Institutions and many leading Textile Mills. As in the earlier years, a number of samples from different parties were tested on Uster classimat as also in Open end spintrainer. The recently installed Knitting Units also have evolved considerable interest for undertaking knitting trials among reputed textile organisations. The number of samples received for tests during the period from January 1989 to March 1990 together with samples tested for the years 1986 to 1988 and for the quinquennium 1981 to 1985 are given below :

TABLE : NUMBER OF SAMPLES RECEIVED FOR PAID TEST

Type of Tests	Average for the quiquennium 1981 to 1985	1986	1987	1988	(January 1989 to March 1990) 1989-90
Spinning	50	59	22	105	250
Fibre Tests	117	459	337	1457	3685
Yarn Tests	145	182	142	93	89
Fabric Tests	60	36	57	40	93
Moisture Tests	31	28	37	3	0
Miscellaneous Tests	32	9	18	23	23
Total	519	773	613	1721	4140

The total fees collected from Paid Tests during the fifteen months period from January 1, 1989 to March 31, 1990 was Rs. 3,84,383/- as against Rs. 1,76,038/- collected at the calendar year 1988.

Besides routine tests, the following special tests were also carried out on samples received from various outside organisations :

1. One cotton fibre sample received from a reputed firm in Madurai was subjected to X-ray characterisation.
2. Three samples of polymer films received from a plastic and polymer firm at Aurangabad were tested for IR crystallinity.
3. Two chemical samples received from a firm in Baroda were subjected to X-ray characterisation.
4. Two fabric samples from SITRA, Coimbatore were subjected to anti-bacterial tests.
5. Calibration and standardisation have been undertaken and completed on eight stelometers submitted for test by an engineering firm at Thane, Maharashra State.
6. SEM studies were undertaken, of molecular migration and agglomeration on the surface of moulded polymer parts submitted by a manufacturing company of Bombay.

Training :

(a) Two full time training courses each of two months duration were conducted on 'Cotton Testing Mehods' for persons deputed by cotton trading organisations, industry and co-operative marketing organisations.

In the first batch, there were 6 trainees and in the second batch 12 and the total fees realised for the two batches was Rs. 21,600/-

(b) Two Weeks' special training course was conducted for the technical personnel of the Maharashtra State Co-operative Cotton Growers, Marketing Federation, Ltd. as well as Punjab Co-operative Spinning Mills, Federation Ltd. The course held in three batches had 12 trainees.

(c) Two weeks' training course in 'Cotton Testing Methods' exclusively for cotton graders sponsored by the Maharashtra State Co-operative Cotton Growers Marketing Federation Ltd. was conducted in six batches and another batch of four, consisting of Agriculture Officers from Karnataka State Department of Agriculture, Bangalore were also trained from October 16 to 28, 1989. A few Assistant Managers from Cotton Corporation of India also had been accommodated in some batches for the training. In total there were 115 officers who completed this two weeks training course. The total course fees realised was Rs. 57,500/-.

(d) In-house training was given to three Technical Assistants working at the Quality Evaluation Units of Akola, Rahuri and Sriganganagar, for a period of 15 days from July 3 to July 17, 1989.

(e) The following foreign dignitaries visited CTRL under different sponsorship programmes of FAO, UNDP, TETC, etc. and underwent training for a week duration.

EXTENSION

S. No.	Name	Institute	Period
1.	Mr. Duong Viet Thanh	Nhaho Research Centre, Thuan Hai Province, Vietnam	17-12-1988 to 21-12-1988
2.	Mr. Vit Van Thieu	Quou, The State Farm, Thuan Hai Province, Vietnam	„
3.	Mr. Tran Van	Long Air Province, SR of Vietnam	„
4.	Mr. Tran Van Cuong	Provincial Agricultural Department, Dong Nai Province, Vietnam	„
5.	Mr. P. D. Cvong	National Cotton Co., Vietnam	26-12-1988 to 3-1-1989
6.	Mr. H. T. Viet	„	„
7.	Mr. P. G. Linh	„	„
8.	Mr. H. D. Bau	Cotton Research Centre, NHAHO, Vietnam	„
9.	Mr. N. D. Quang	„ „	„
10.	Mr. N. D. Long	„ „	„
11.	Mr. N. T. Dung	„ „	„
12.	Miss B. T. Ngog	„ „	„
13.	Dr. Nguyen Thi Bau	Deputy Director, Textile Research Institute, Moli, Vietnam	11-8-1989 to 20-8-1989
14.	Mr. Chu Aro Lai	Textile Engineer, Textile Research Institute, Moli, Vietnam	„ „
15.	Mr. Vu Trono Tho	Sps. Engineer, Textile Research Institute, Moli, Vietnam	„
16.	Mr. Ha Thanh Phong	Textile Economist, Textile Research Institute Moli, Vietnam	„
17.	Mr. Nguven Due	Moli, Vietnam Sps. Engineer, Textile Research Institute,	„
18.	Dr. Nguyen Tho	Director General, National Cotton Co. Vietnam	13-12-1989 to 16-12-1989
19.	Mr. Le Kim Hy	Deputy Director, Cotton Research Centre, Vietnam	„

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Conference and Symposia

Director and Scientists of the Laboratory participated in the following scientific and technological Conferences besides Meetings connected with the work of this Laboratory.

Sl. No.	Meeting/Conference/ Seminar/Symposia, etc.	Place	Date	Name(s) of the Scientist(s) and Technical Personnel who attended the Conference/Meeting, etc.
1.	Symposium on Nonwovens	BTRA, Bombay	04-1-89	Dr. K. R. Krishna Iyer and Dr. V. G. Munshi
2.	25th Annual Convention of Indian Society of Agricultural Engineers	Udaipur	05-1-89 to 07-1-89	Dr. G. R. Anap
3.	30th Joint Technological Conference of ATIRA, BTRA, NITRA, and SITRA	ATIRA, Ahmedabad	03-2-89 & 04-2-89	Dr. V. G. Munshi, Shri B. Srinathan Shri S. K. Chattopadhyay and Miss Indira Iyer
4.	29th Annual Conference of the Association of Microbiologists' of India	Hisar	09-2-89 to 11-2-89	Dr. V. G. Khandeparkar Dr. R. H. Balasubramanya and Dr. S. G. Gayal
5.	National Seminar on Futuristic Approaches for Cotton	Haryana Agricultural University, Hisar	24-2-89 & 25-2-89	Dr. V. K. Madan
6.	AICCIP North Zone Panel Meeting	Chandrasekhar Azad University, Kanpur	04-4-89 & 05-4-89	Dr. N. B. Patil and Shri B. M. Petkar

CONFERENCES AND SYMPOSIA

Sl. No.	Meeting/Conference/ Seminar/Symposia, etc.	Place	Date	Name(s) of the Scientist(s) and Technical Personnel who attended the Conference/Meeting, etc.
7.	Golden Jubilee Conference) of All India Textile Conference of The Textile Association (India)	Bombay Unit	09-4-89 & 10-4-89	Shri M. S. Parthasarathy, Dr. V. G. Munshi, Shri B. Srinathan and Shri K. S. Bhyrappa
8.	AICCIP Central Zone Panel Meeting	Punjabrao Krishi Vidyapeeth, Akola	17-5-89 & 18-5-89	Shri B. M. Petkar
9.	AICCIP South Zone Panel Meeting	Tamil Nadu Rice Research Institute, Aduthurai	05-6-89 & 06-6-89	Dr. N. B. Patil and Shri B. M. Petkar
10.	Third Training Course in Technical Communication	Sugarcane Breeding Institute, Coimbatore	18-9-89 to 20-9-89	Shri T. K. M. Das
11.	International Workshop and Conference on Photography	New Delhi	01-10-89 to 05-10-89	Shri R. M. Modi
12.	All India Co-ordinated Project on Bollworm Resistance Meeting	CICR, Nagpur	14-10-89	Dr. V. G. Khandeparkar and Dr. R. H. Balasubramanya
13.	Seminar on Cotton Development during Golden Jubilee of CTRL Regional Quality Evaluation Unit, Nanded	Marathwada Agricultural University, Nanded	16-10-89 & 17-10-89	Dr. N. B. Patil, Dr. V. G. Munshi, Dr. V. G. Khandeparkar, Dr. G. R. Anap, Shri Muntazir Ahmed, Dr. R. H. Balasubramanya and Shri L. D. Deshmukh
14.	Fifth National Convention of Textile Engineers and All India Seminar on Industrial Speciality Fabrics	The Institution of Engineers (India), Bombay Unit, Bombay	15-12-89 & 16-12-89	Shri M. S. Parthasarathy and Shri B. Srinathan

Sl. No.	Meeting/Conference/ Seminar/Symposia, etc.	Place	Date	Name(s) of the Scientist(s) and Technical Personnel who attended the Conference/Meeting, etc.
15.	Twelfth All India Workshop Meeting of AICCIP	University of Agricultural Sciences, Dharwad	04-1-90 & 05-1-90	Dr. N. B. Patil and Shri B. M. Petkar
16.	Seminar on Modernisation of Ginning Industry	Karnataka Chamber of Commerce	20-1-90	Dr. G. R. Anap
17.	International Seminar on Nonwovens	BTRA, Bombay	22-1-90 & 23-1-90	Dr. K. R. Krishna Iyer
18.	XXVI Annual Convention of Indian Society of Agricultural Engineers	Haryana Agricultural University, Hisar	07-2-90 to 09-2-90	Dr. G. R. Anap
19.	31st Joint Technological Conference of ATIRA, BTRA, NITRA, SITRA	NITRA, Ghaziabad	16-2-90 & 17-2-90	Dr. P. K. Chidambareswaran and Smt. J. K. S. Warrier
20.	First Zonal Meeting & Seminar on (1) Education and Training in Pulp and Paper Technology and (2) Energy Management in Pulp and Paper Industry	Institute of Paper Technology, Saharanpur	17-2-90	Dr. (Kum.) I. G. Bhatt and Shri R. M. Gurjar

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Summary of the Report

This is the sixty-sixth Annual Report which covers the period January 1989 to March 1990.

The Cotton Technological Research Laboratory (CTRL) formerly known as the *Technological Laboratory* was established in January 1924 by the *erstwhile* Indian Central Cotton Committee. With the abolition of commodiy committees including ICCC, the administrative control of CTRL was passed on to the Indian Council of Agricultural Research (ICAR) with effect from April 1, 1966 and research activities were re-oriented and intensified since then, to meet the challenges in respect of production and quality of cotton grown in the country.

The major functions of CTRL are as follows :

1. To participate actively in the programmes for improvement in the production and quality of cotton in India, by evaluating the quality of new strains evolved by agricultural scientists and giving them necessary technical guidance.
2. To carry out research on physical, structural and chemical properties of cotton in relation to quality and procesing performance.
3. To carry out research investigation on the ginning problems of cotton.
4. To investigate the greater and better utilisation of cotton, cotton wastes, linters, cotton seeds, etc.
5. To help the trade and industry by providing reliable and accurate data on quality of representative trade varieties of Indian cottons.
6. To issue authoritative reports on the samples received for tests from Government, the trade and other bodies.
7. To collect and disseminate technical information on cotton.

As could be seen from the organisational Chart given in Annexure I, Director is the head of this institute ably assisted by a team of Scientists, Technical Officers and other Staff.

CTRL has 13 Regional Quality Evaluation Units at the chief cotton breeding centres in the country, viz. Akola, Coimbatore, Dharwad, Guntur, Hissar, Indore Ludhiana, Nagpur, Nanded, Rahuri, Sirsa, Sriganganagar and Surat. Preliminary screening of experimental strains with respect of chief fibre properties are being carried out in these Regional Units. In addition,

CTRL has a Ginning Training Centre at Nagpur, where, regular courses for training gin fitters and supervisors are conducted.

As in the previous years, CTRL continued to collaborate actively with Agricultural Universities and State Departments of Agriculture in their endeavour to evolve new improved cotton varieties in terms of quality and yield, better utilisation of cotton and cotton plant by-products. CTRL continued to play a major role in cotton improvement research under the AICCIP by (i) laying down norms for fibre properties, (ii) continuous monitoring of the fibre quality of the breeders' materials at various stages of breeding so as to enable the breeders to take corrective measures, whenever necssary, (iii) tchnological evaluation of pre-release materials through detailed fibre tests, ginning and spinning trials, and (iv) final evaluation through mill trials. More than 13,000 samples belonging to various trials were tested for fibre properties and spinning performance at the headquarters and at the regional units. The total number of books in the library was 4212 with the addition of 178 books during 1989-90. Abstracts of articles were continuously supplied for the TEXINCON of the National Information Centre for Textile and Allied subjects (NICTAS) functioning at ATIRA, Ahmedabad.

All ongoing as well as new research projects taken up under various disciplines have been grouped under six distinct thrust areas identified for the institute keeping in view the mission oriented approach envisaged for problems within the frame work of the objectives laid down for CTRL, in particular and ICAR, in general.

THRUST AREA I : TECHNOLOGICAL RESEARCH FOR COTTON QUALITY EVALUATION AND IMPROVEMENT

At the panel meetings of the AICCIP, the following six new varieties have been recommended for release for general cultivation.

1. LH.1134
2. NHB.12
3. CICR.H.H.1
4. HB.224
5. DDH.2
6. MECH.4

Under the programme for Technological Evaluation of Germplasm material, a total of 727 samples were evaluated for main quality characters.

For the evaluation of spinnability of cottons from single thread strength of Micro spun yarns, 140 samples were tested and results analysed. It was observed that single thread yarn tenacity of micro spun yarns are less than that of full spinning samples and that the CV% of yarn strength of Micro spun yarn is much higher than that of full spinning yarns.

Quality of cotton fibres from plants affected by a new wilt was studied with 35 cultivars and it was observed that the wilting phenomenon has not been genetic and that the peculiar agro-climatic conditions prevailed during the growing period and at the boll formation stage has resulted in wilting.

In connection with an assessment of fibre quality parameters by HVT and their influence on spinnability of cotton, a new constant was worked out for correcting strength values obtained on HVT. Based on actual CSP values of 84 cottons, two regression

equations were arrived at using HVT parameters :

$$CSP = 902 + 25.8\ (L) + 12.1\ (UR) + 8.5\ Mic + 8.6\ Str \quad (i)$$

$$CSP = 1216.9833 + 9.0817 \times FQI \quad (ii)$$

Where,

L	=	2.5% Span Length(mm)
UR	=	Uniformity Ratio (%)
Mic	=	Micronaire Value
Str	=	Tenacity (3.2 mm) in g/t
FQI	=	Fibre Quality Index

For a study on inheritance of fibre length in *hirsutum* cottons, ten established varieties were sown in 1989. There were 24 crosses for 1990.

Variation in ribbon width of *desi* hybrid cottons were investigated on 108 samples derived from eight parents and 28 hybrids in 3 replications. 100 fibres from each sample was subjected to ribbon width measurement using projection microscope and the results were compiled and CV percentage calculated.

THRUST AREA II : POST HARVEST TECHNOLOGY OF COTTON

A survey of the conditions of ginning factories in Madhya Pradesh has been completed in collaboration with the East India Cotton Association, Bombay. A report highlighting various observations and recommendations based thereon, has been prepared and published. The survey for Karnataka State has been completed and the data collected are being analysed.

An inclined type pre-cleaning machine was fabricated and tested. The machine can provide cleaned *Kapas* to feed about 20 double roller gins. Besides being suitable for *Kapas* from all varieties, the cleaner is also able to eliminate immature locks.

A study on combing of Pima Cotton revealed that there is considerable reduction in the incidence of seed coat fragments as well as other trash as a result of combing. The study also showed that while the faults as determined by Uster Classimat in A and B classes gradually reduced with increase in the level of noil extraction, those in C and D classes recorded only marginal improvement beyond 10% noil extraction.

In an investigation on the incidence of yarn faults in blended (Polyester/Viscose) rotor and ring spun yarns, the following findings were made : (i) the strength of rotor spun yarn was lower than that of ring spun yarn by as much as 25% unlike in case of pure cotton where the difference is generally small; (ii) with coarser polyester component in the blend however, the difference was reduced; (iii) the quality gap between rotor and ringspun yarn was also diminished when the yarns were doubled.

For the study of comparison of yarn bundle strength with lea strength, two jaw attachments to the lea strength tester were fabricated and tested.

THRUST AREA III : STRUCTURE, PROPERTY AND THEIR INTER RELATIONSHIPS IN TEXTILE MATERIALS

Enzymolysis of never-dried cotton cellulose from three varieties of cotton belonging to *G. arboreum* showed that crystallinity does not decrease during the course enzymolysis. This perhaps points out the peculiarity of *G. arboreum* cotton as com-

pared to those of *G. hirsutum* and *G. barbadense*. The chain length distribution might also have been different in cottons belonging to *G. arboreum*.

Lattice conversion behaviour of cotton fibres was studied by using different swelling agents and five distinct regions of order were clearly brought out in the lateral order distribution (LOD) Curve. It was found that LiOH and CsOH are most useful fine structural probes for cotton fibre.

Twenty-five cotton varieties drawn from all four major botanical species were tested for a range of physical and structural properties. From the analysis of data thus generated, many interesting observations on structure-property relations have been made.

A study of crystallinity and orientation during slow drying of never-dried cotton fibres indicated that improvement in these properties depends on the variety as well as on the maturity level. Crystallisation during growth showed a slowing down tendency in the intermediate stage of cell wall development.

Analysis of the structural and tensile behaviour of cotton fibres swollen in LiOH, NaOH and KOH at different temperatures and in various concentrations revealed that KOH treatment is superior. The tenacity retention at all the gauge lengths was found to be better after KOH treatment for all varieties thus sudied.

A number of physical properties were determined on cellulosic fibres other than cotton as part of a programme for preparing full technical information on these fibres. The samples tested so far included three varieties of sisal, four varieties of banana and three varieties of coconut coir.

An attachment to the Instron Tensile Tester has been designed and fabricated for measuring frictional characteristics of textile fibres. For measurement of electrical conductivity of cotton fibres/yarns, an experimental set up has been prepared. An SEM study of morphological deformities has shown that nearly all the deformities present in the raw fibres are removed by stretch mercerisation. In another study, the relaxation of molecular orientation in stretched fibres is being monitored by measurement of birefringence. Tests are being carried out on wool and polyester fibres.

THRUST AREA IV : CHEMICAL PROCESSING AND FINISHING TREATMENTS

In connection with the evaluation of the response of resin finishing treatments on decrystallised and stabilised cotton yarn, modification treatments were carried out on yarn and fabric samples. It was observed that the pre-treatment before cross-linking reduces the strength loss without sacrificing the crease recovery property.

To impart anti-soiling finish to cotton/polyester blended fabrics, finishing treatments were done with carboxymethyl cellulose, DMDHEU and Zinc nitrate. Treatments were carrieed out in the presence of softeners of different ionic nature to improve the resilience as well as anti-soiling property. Silicon based softeners gave good anti-crease and anti-soiling property to treated fabric.

In a study relating to development of an antibacterial finish for cotton fabrics, preliminary trials were conducted to standardise the concentration of Zinc acetate in the finishing bath, temperature and time. The durability of the finish was tested by repeated launderings and it was found that all the treated samples retained 100% antibacterial property even after several washes.

A comparative study of the dyeing behaviour of rotor and ring spun yarn samples was made by using direct, vat and reactive dyes. From visual assessment, it was apparent that dyeing performance of rotor spun yarn is superior to that of ring spun yarns.

The effect of three washing methods, viz. (i) Hand washing (ii) Launderometer and (iii) Domestic washing machine on the physical and mechanical properties of cotton, polyester and blended (P/C) fabrics has been studied. It was observed that strength, abrasion resistance and tear strength were reduced by washing. Amongst the three methods, washing in domestic washing machine appeared to be the most severe followed by hand washing and launderometer washing.

THRUST AREA V : UTILISATION OF BY-PRODUCTS OF COTTON AND PROCESSING WASTES

In connection with the bio-enrichment of cotton seed hulls and preparation of protein hydrolysates from cotton seed meal, the protein hydrolysate obtained from trypsin was evaluated on the basis of colony characteristics of some bacteria. It was observed that the cotton seed meal hydrolysate was comparable with commercial products except for *E. Coli*, where the size of the colonies was smaller. The hydrolysates were incorporated in the Tendlers' Non Synthetic Medium and *B. subtilis*-159 was grown for 48 hr in shake flasks. The results indicated a two and half times increase in amylase production as compared to commercial peptone. The cellulase production of *P. funiculosum* F.4 on cotton seed meal hydrolysates indicated higher cotton and filter paper activities as compared to commercial product.

Fermentation studies on the production of cellulase by *Penicillium funiculosum* (F-4) have shown that *Penicillium funiculosum* (F-4) grows well in a 5 litre modular fermenter and could produce the same amount of cellulase as could be produced in a 250ml flask.

In a study on thermal stability of refined cotton-seed oil heated to 180°C it was found that the iodine value decreased steadily with increase in heating time, while peroxide values increased and then decreased indicating breakdown of hydroperoxides formed. Anisidine and totox values increased with increase in heating time, while increase in fatty acids was only marginal. There was no rancid smell upto 12 hours.

Studies on rancidity of cotton seed oil were continued. A sample of refined cotton seed oil was stored at room temperature in a plastic container after addition of antioxidants as well as other vegetable oils. Of the four antioxidants tried, only TBHQ was found to be effective in increasing the shelf life of refined cotton seed oil by about

three months. Addition of fresh *til* oil also was found effective in increasing shelf life of refined cotton seed oil.

The study relating to preparation of particle board from cotton stalk has been continued. Multilayered boards with coarse particles in the middle and fine particles in the outer layers with weight ratio 60:40 (coarse:fine) were found to be of satisfactory quality. Conditions with regard to pressure and resin add-on were standardised for making low density boards from cotton stalk suitable for thermal insulation.

Trials were undertaken to standardise the cooking conditions to get good quality thermo-mechanical pulp and to identify the pressure cycle for making good quality hard boards from cotton plant stalks.

Pilot plant trials for making paper from cotton stalk were carried out at Ellora Paper Mills, Tumsar and about one tonne of writing paper was produced. A pulping process for news print grade pulp is being standardised.

THRUST AREA VI : ORIGIN OF COTTON DUST AND ITS CONTROL

In connection with the study on cotton plant materials and cotton dust using X-Ray Fluorescence Spectroscopy, 75% of the quantitative scans of different plant samples taken up was recorded.

A study on characterisation of various cotton plant parts for microflora in relation to elemental composition has established the presence of *Bijerinckia Sp,* on various plant parts of both glanded and glandless cotton varieties. However, bracts which constitute a major portion of the cotton dust, from glandless varieties did not show these bacteria.

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Personnel

Major events during 1989-90 under personnel function at CTRL are given below :

A. APPOINTMENTS

Sr. No.	Name	Grade	Effective date of appointment
		Technical Staff	
1.	Shri H. S. Jayaprakash Narayan	Sr. Technical Assistant T-4	03-11-1989
2.	Shri G. Vijayan Iyer	,,	30-12-1989
3.	Shri U. D. Devikar	Technical Assistant T-II-3	13-10-1989
4.	Shri H. S. Koli	,,	13-10-1989
5.	Shri R. G. Dhakate	,,	16-10-1989
6.	Shri Seeta Ram	,,	16-10-1989
7.	Kum. M. K. Sugatha K. Kumari	,,	25-10-1989
8.	Shri S. N. Wani	,,	16-11-1989
9.	Shri R. K. Jadhav	,,	18-12-1989
10.	Smt. Nirupama Panda	,,	04-12-1989
11.	Shri P. N. Sahane	,,	26-02-1990
		Auxiliary Staff	
1.	Shri R. N. Kadam	Driver	21-10-1989
2.	Shri R. R. Khurdekar	Operator	18-12-1989
3.	Shri V. Y. Unhalekar	,,	18-12-1989

Sl. No.	Name	Grade	Effective date of appointment
		Administrative Staff	
1.	Shri M. K. Jain	Administrative Officer	01-02-1989
2.	Shri Niraj Kumar Dixit	Hindi Assistant	30-08-1989
3.	Shri S. V. Chindarkar	Junior Clerk	08-02-1989
4.	Shri V. M. Sable	,,	25-05-1989
5.	Smt. J. R. Chavkute	,,	06-06-1989
6.	**Shri B. T. Dhongade**	Junior Stenographer	28-07-1989
7.	Shri Pradeep Kumar Vasu	Junior Clerk	31-07-1989
		Supporting Staff	
1.	Shri Y. P. Kamble	Grade I	01-04-1989
2.	Shri S. K. Bobate	,,	12-04-1989
3.	Shri I. P. Tomaskar	,,	11-08-1989
4.	Shri Prakash Patil	,,	06-12-1989
5.	Shri S. N. Umare	,,	15-12-1989
6.	Shri Mahabir Singh	,,	12-01-1990
7.	Shri Ramnivas G. Tak	,,	20-01-1990
8.	Shri R. P. Karkate	,,	07-02-1990
9.	Shri S. B. Worlikar	,,	17-02-1990
10.	Shri N. D. Walzade	,,	31-03-1990

B. ASSESSMENT

Technical Staff

The Five Yearly assessment of eligible Technical Personnel of CTRL was held and promotions/advance increments granted as detailed below :

Promotions

Sr. No.	Name	Grade to which promoted	Effective date of promotion
1.	Shri M. M. Shailkh	Senior Technical Assistant T-4	01-01-1983
2.	Shri S. G. Dalvi	,,	01-07-1983
3.	Shri D. L. Upadhye	,,	01-07-1987

Advance Increments

Sr. No.	Name	Grade	No. of advance increments	Effective date of increment
		Technical Staff		
1.	Smt. Santa V. Nayar	Technical Officer T-5	One	01-01-1989
2.	Shri C. P. Venugopalan	,,	,,	01-01-1989
3.	Shri M. C. Bhalod	,,	,,	01-07-1989
4.	Shri K. V. Anantha Krishnan	Technical Officer T-5	Two	01-07-1989
5.	Shri C. R. S. Moni	,,	,,	01-07-1989
6.	Shri K. B. Rajagopal	Senior Technical Assistant T-4	,,	01-01-1989
7.	Shri R. S. Darade	,,	,,	01-01-1989
8.	Shri S. Sekar	,,	,,	01-01-1989
9.	Shri S. J. Guhagarkar	,,	,,	01-01-1989
10.	Shri D. Radhakrishnamurthy	,,	,,	01-01-1989
11.	Smt. R. K. Sahani	,,	,,	01-01-1989
12.	Shri I. H. Hunsikatti	,,	,,	01-07-1989
13.	Smt. A. A. Kathe	,,	Three	01-07-1989
14.	Shri M. M. Shaikh	Technical Assistant T-II-3	One	01-01-1982
15.	Shri S. G. Dalvi	,,	Two	01-07-1982
16.	Shri D. L. Upadhye	,,	One	01-07-1986
17.	Shri D. V. Kambli	Technical Assistant T-I-3	One	01-01-1989
		Auxiliary Staff*		
	Shri P. K. Gopalan	Technical Assistant T-2	One	01-01-1989
	Shri Bechan Nokhai	,,	Two	01-01-1989
	Shri K. Vasudevan Nair	,,	Two	01-01-1989
	Shri H. K. Pawar	,,	Three	01-01-1989

* Holding Technical posts as personol to the m.

C. PROMOTIONS

Administrative Staff

Shri P. D. Sonawane to the post of Assistant Administrative Officer w.e.f. 31-12-1988.

Shri D. P. Naidu to the post of Superintendent w.e.f. 02-01-1989 .

Smt. S. S. Shanbhag to the post of Assistant w.e.f. 02-01-1989.

Shri E T. Gurav to the post of Senior Clerk w.e.f. 04-04-1989.

Shri G. Moosad to the post of Superintendent w.e.f. 01-03-1990.

Auxiliary Staff

Shri G. S. Deorukhkar to the post of Operator w.e.f. 18-12-1989.

Shri B. R. Jadhav to the post of Operator w.e.f. 18-12-1989.

Shri M. B. Chandanshive to the post of Operator w.e.f. 18-12-1989.

Shri A. B. Sawant to the post of Gestetner Operator w.e.f. 17-01-1990.

Supporting Staff

Shri A. B. Sawant to the post of Supporting Staff Gr. III w.e.f. 01-07-1989.

Shri O.T. Thapa to the post of Supporting Staff Gr. II w.e.f. 01-07-1989.

Shri B. R. Satam to the post of Supporting Staff Gr. II w.e.f. 12-03-1990.

Shri D. M. Chowgule to the post of Supporting Staff Gr. II w.e.f. 12-03-1990.

Smt. T. V. Bhowar to the post of Supporting Staff Gr. II w.e.f. 12-03-1990.

D. TRANSFERS

Scientific Staff

Shri U. N. Borkar, Scientist from Ginning Training Centre, Nagpur to Jute Agricultural Research Institute, Barrackpur w.e.f. 31-08-1989.

Technical Staff

Shri Ram Parkash, Technical Officer T-7 from Q.E. Unit of CTRL, Sriganganagar to Q.E. Unit of CTRL, Ludhiana w.e.f. 06-02-1989.

Shri B. S. Ganvir, Technical Officer T-6 from Q.E. Unit of CTRL, Indore to CTRL Headquarters w.e.f. 21-12-1989.

Shri S. J. Guhagarkar, Senior Tech. Asstt. T-4 from CTRL, Headquarters to Q.E. Unit of CTRL, Sirsa w.e.f. 21-12-1989 and back to Headquarters w.e.f. 19-03-1990.

Smt. Vishala Devender, Senior Tech. Asstt. from CTRL Headquarters to National Research Centre for Sorghum, Hyderabad w.e.f. 06-05-1989.

Shri Udai Vir Singh, Tech. Asst. T-11-3 from Q.E. Unit of CTRL, Ludhiana to Q.E. Unit of CTRL, Sriganganagar w.e.f. 08-02-1989.

Shri S. L. Bhanuse, Tech. Asstt. T-II-3 from CTRL Headquarters to Ginning Training Centre, Nagpur w.e.f. 20-03-1989.

Shri D. N. Moon, Tech. Asstt. T-II-3 from Q.E. Unit of CTRL, Nanded to CTRL Headquarters w.e.f. 22-05-1989.

Shri Gyan Singh, Tech. Asstt., T-II-3 from Ginning Training Centre Nagpur to Indian Agricultural Statistics Research Institute, New Delhi w.e.f. 18-12-1989.

Shri Sita Ram, Tech. Asstt. T-II-3 from CTRL Headquarters to Q.E. Unit of CTRL, Sirsa w.e.f. 21-12-1989.

Administrative Staff

Shri N. S. Sekaran, Audit and Accounts Officer from National Research Centre for Spices, Calicut on promotion joined CTRL Headquarters as Finance and Accounts Officer w.e.f. 11-08-1989.

Shri B. T. Dhongade, Jr Stenographer from CTRL Headquarters to National Research Centre for Citrus, Nagpur w.e.f. 12-01-1990.

Shri S. A. Telpande, Jr. Clerk from CTRL Headquarters to Ginning Training Centre, Nagpur w.e.f 24-02-1990.

Supporting Staff

Shri T. B. Khan, S. S. Gr. I from Ginning Training Centre, Nagpur to CTRL Headquarters, w.e.f. 20-03-1990.

Shri M. P. Tohokar, S. S. Gr. I from Ginning Training Centre, Nagpur to Q.E. Unit of CTRL, Akola w.e.f. 21-03-1990.

Shri S. N. Gope, S. S. Gr. I from Ginning Training Centre, Nagpur to CTRL Headquarters w.e.f. 22-03-1990.

Shri Butnislal Balmiki, S.S.Gr. II from CTRL Headquarters to Indian Veterinary Research Institute, Izatnagar w.e.f. 25-11-1989.

E. RESIGNATIONS

Shri A. S. Jaywant, Tech. Asstt. T-II-3 resigned from service w.e.f. 27-05-1989.

Shri S. V. Chindarkar, Jr. Clerk resigned from service w.e.f. 28-02-1989.

Shri Y. P. Kamble S. S. Gr. I resigned from service w.e.f. 12-10-1989.

F. RETIREMENTS

Shri T. N. Ramamurthy Rao, Principal Scientist retired from service w.e.f. 31-10-1989.

Shri M. S. Sitaram, Technical Officer T-7 retired from service w.e.f. 31-08-1989.

K. Chandran, Technical Officer T-5 retired from service w.e.f. 28-02-1990.

Shri M. M. Shaikh, Sr. Tech. Asstt., T-4 retired from service w.e.f. 28-02-1990.

Shri K. S. Deshpande, Superintendent, retired from service w.e.f. 28-02-1990.

Shri Obilal Parsuram, S.S. Gr. III retired from service w.e.f. 30-06-1989.

Shri Babu Aba Babar, S.S. Gr. III retired from service w.e.f. 31-01-1990.

G. DEPUTATION ABROAD

Dr. K. R. Krishna Iyer, Principal Scientist was deputed to U.K. for study on the structure of knitted and non-woven fabrics and methods of testing their physical and mechanical properties for a period of 9 months from March 30, 1989.

Shri N. Thejappa, Scientist, was deputed to Norwalk, U.S.A., for training in the operation and maintainance of high pressure liquid chromatograph for a period of 4 days from July 17, 1989.

Dr. R. H. Balasubramanya, Scientist S.G., was deputed to Cambridge, U.K., for a comprehensive course of training in Automatic Amino Acid Analyser for a period of 4 days from July 17, 1989.

Shri A. V. Ukidve, Scientist (S.G.) visited the Arab Republic of Egypt, for a period of 14 days from December 17, 1989 to 01-01-1990 under Indo-ARE work plan, 1989-90.

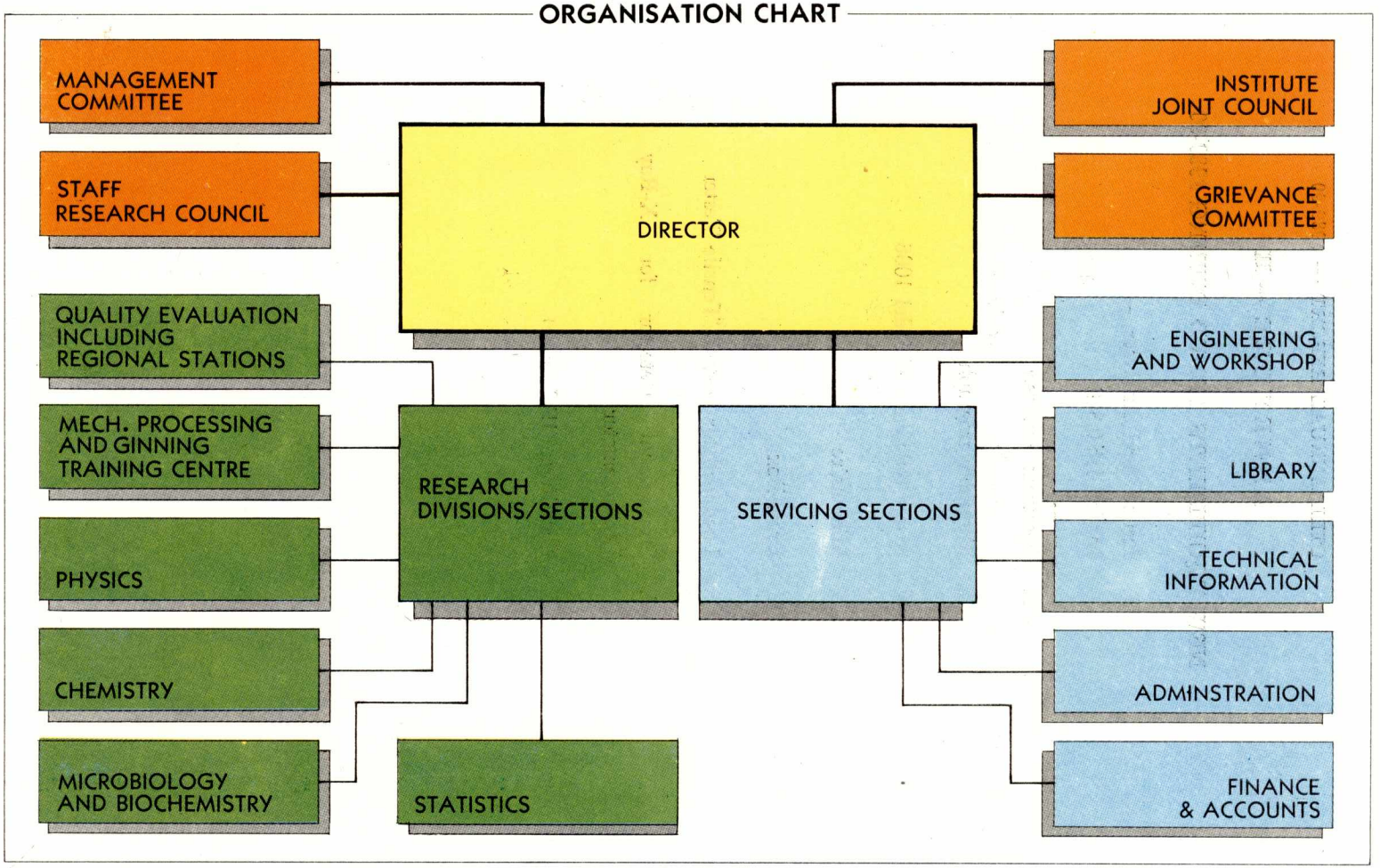
H. OBITURY

Shri K. V. Vasu, Finance and Accounts Officer expired on 21-3-1989.

ANNEXURE — I

COTTON TECHNOLOGICAL RESEARCH LABORATORY

ORGANISATION CHART



ANNEXURE — II

NEW EQUIPMENTS ADDED DURING 1989-90

1. Amino Acid Analyser — Model 415.0.302
2. Spectrum Analyser
3. Thermohygrograph
4. Avery Balance — Model 1006
5. Micronaire
6. Draw-Box
7. Load cell for Instron Tensile Tester
8. Proportional Detector for X-Ray Diffractometer
9. Centrifuge (IEC make)

ANNEXURE — III

DISTINGUISHED VISITORS

1. Mr. George Ruppenicker,
Cotton Technologist,
Southern Regional Research Centre,
U.S. Department of Agriculture,
New Orlens, USA.

2. Dr. V. S. Venkatavaradan,
Director,
Nehru Planetarium, Worli, Bombay.

3. Dr. Nguyen Thi Bau,
Deputy Director,
Textile Research Institute,
Moli, Vietnam.

4. Mr. Chu An Lai
Textile Engineer,
Textile Research Institute,
Moli, Vietnam.

5. Mr. Vu Trong Tho,
Spinning Engineer,
Textile Research Institute,
Moli, Vietnam.

6. Mr. Ha Thanh Phong,
Textile Economist,
Textile Research Institute,
Moli, Vietnam.

7. Mr. Nguven Due,
Spinning Engineer,
Textile Research Institute,
Moli, Vietnam.

8. Mr. He Kang,
Minister of Agriculture,
China.

9. Mr. Wang Ganhang,
Director,
Department of Agriculture,
China.

10. Mr. Hong Shaohong,
Director,
Department of Agriculture,
Hainan Province, China.

11. Mr. Bai Zhenghuan,
Director,
Division of Asia and Africa of Department of Foreign Affairs,
Ministry of Agriculture, China.

12. Mr. Fei Kaiwei,
Deputy Director,
Department of Science and Technology,
Ministry of Agriculture, China.

13. Mr. Gong Guangun,
Officer,
Division of Asia Africa of Department of Foreign Affairs,
Ministry of Agriculture, China.

14. Mr. Liu Guangning,
Counsellor,
Department of Science and Technology,
Chinese Embassy, New Delhi.

15. Dr. Har Swarup Singh,
Vice Chancellor,
Haryana Agricultural University,
Hissar.

16. Shri G. Venkataramani,
Agriculture Correspondent,
The Hindu, Madras.

ANNEXURES

ANNEXURE — IV

FINANCIAL STATEMENT (a)

EXPENDITURE AND RECEIPTS OF LABORATORY DURING 1988-89

	Sanctioned Grant Rs.	Actual Expenditure Rs.	Savings(—) Deficit (+) (Rs.)
A. EXPENDITURE			
I. CTRL including Q.E. Units (Non. Plan)			
(a) Capital expenditure including expansion of the Laboratory	12,86,000.00	12,86,795.73	(+) 795.73
(b) Working Expenditure	94,14,000.00	99,93,491.47	(+)5,79,491.47
	1,07,00,000.00	1,12,80,287.20	(+)5,80,287.20
II. (Plan)			
(a) Capital expenditure including expansion of the Laboratory	8,50,000.00	8,47,781.60	(—) 2,218.40
(b) Working expenditure	11,50,000.00	8,86,202.40	(—)2,63,797.60
	20,00,000.00	17,33,984.00	(—)2,66,016.00
III. PL-480 Research Project FG-IN-672 entitled "Cotton Fibre Tensile Properties in Relation to Its Morphological and Fine Structure Parameters".	—	58,906.05	—

B. RECEIPTS

Sale proceeds of fruits, vegetables, plants, etc.	32,596.45
Sale proceeds of vehicles, tools, plants and other non-consumable stores	—
Analytical and testing fees	32,237.00
Rent	2,62,142.00
Fees for training, application fees, etc.	62,689.00
Sale of publications	69,900.00
Receipts from services rendered by Instt.	2,963.25
Interest on loans & advances granted to Council's employees	1,500.00
L.S. & Pension contributions	36,446.00
Miscellaneous receipts	80.00
	14,66,306.10
	19,66,859.80

FINANCIAL STATEMENT (b)

EXPENDITURE AND RECEIPTS OF LABORATORY DURING 1989-90

	Sanctioned Grant Rs.	Actual Expenditure Rs.	Savings(—) Deficit (+) (Rs.)
A. EXPENDITURE			
I. CTRL including Q.E. Units (Non. Plan)			
(a) Capital expenditure including expansion of the Laboratory	5,44,227.00	5,44,227.00	—
(b) Working Expenditure	1,26,05,773.00	1,26,45,798.00	(+) 40,025.00
	1,31,50,000.00	1,31,90,025.00	(+) 40,025.00
II. (Plan)			
(a) Capital expenditure including expansion of the Laboratory	1,26,296.00	1,26,296.00	—
(b) Working expenditure	14,73,704.00	14,74,234.00	(+) 530.00
	16,00,000.00	16,00,530.00	(+) 530.00
III. PL-480 Research Project FG-IN-672 entitled "Cotton Fibre Tensile Properties in Relation to Its Morphological and Fine Structure Parameters".	—	40,934.00	—

B. RECEIPTS	
Sale proceeds of fruits, vegetables, plants, etc.	71,324.10
Sale proceeds of vehicles, tools, plants and other non-consumables stores	—
Analytical and testing fees	2,44,533.00
Rent	70,746.50
Fees for training, application fees, etc.	90,150.00
Sale of publications	2,682.00
Receipts from services rendered by Instt.	—
Interest on loans & advances granted to Council's employees	1,28,440.00
L.S. & pension contributions	52,273.00
Miscellaneous Receipts	7,28,564.05
	13,88,712.95

9

Appendices

APPENDIX — I

STAFF WORKING AT THE COTTON TECHNOLOGICAL RESEARCH LABORATORY AS ON MARCH 31, 1990

(List does not include Vacant posts)

LIST OF STAFF IN THE HEADQUARTERS

Scientific Personnel

Director

Dr. N. B. Patil, M.Sc., Ph.D.

Principal Scientist

1. Dr. (Kum.) I. G. Bhatt, M.Sc., Ph.D.
2. Dr. P. K. Chidambareswaran, M.Sc., Ph.D.
3. Dr. V. G. Khandeparkar, M.Sc., Ph.D.
4. Dr. K. R. Krishna Iyer, M.Sc., Ph.D., F.T.A.
5. Dr. V. G. Munshi, M.Sc., Ph.D., F.T.A.
6. Shri M. S. Parthasarathy, M.Text. (Bom.) M.Sc. Tech. (Manch.), A.M.C.S.T., Rashtrabasha Ratna
7. Shri B. Srinathan, B.Sc. (Text.), M. Text.

Scientist (Selection Grade)

1. Shri Muntazir Ahmed, B.Sc., B.Text. (Text. Tech.)
2. Dr. R. H. Balasubramanya, M.Sc., Ph.D.
3. Smt. S. P. Bhatawdekar, M.Sc.
4. Dr. S. G. Gayal, M.Sc., Ph.D.
5. Shri G.F.S. Hussain, M.Sc.
6. Dr. (Smt.) P. Bhama Iyer, M.Sc., Ph.D.
7. Smt. J. K. Iyer, M.Sc.
8. Smt. Vatsala Iyer, M.Sc., M. Phil.
9. Shri R. P. Nachane, M.Sc.
10. Smt. Prema Nair, M.Sc.
11. Dr. K. M. Paralikar, M.Sc., Ph.D., F.R.M.S.
12. Shri B. M. Petkar, M.Sc., D.M.
13. Kum. C. R. Raje, M.Sc.
14. Shri D. Rama Rao, M.Sc.
15. Shri A. J. Shaikh, M.Sc.
16. Dr. S. Sreenivasan, M.Sc., Ph.D.
17. Shri A. V. Ukidve, M.Sc., F.T.A.
18. Shri P. V. Varadarajan, M.Sc.
19. Dr. N. C. Vizia, M.Sc., Ph.D.

Scientist

1. Shri P. Bhaskar, M.Sc.
2. Shri S. K. Chattopadhayay, B.Sc. Tech. (Text.), M.Tech. (Text. Engg.)
3. Shri R. M. Gurjar, M.Sc.
4. Shri A. K. Gupta, M.Sc., LL.B., W.P.M.M.T.
5. Shri S. B. Jadhav, M.Sc.
6. Dr. D. N. Makwana, M.Sc., Ph.D.
7. Shri D. V. Mhadgut, M.Sc.
8. Shri G. S. Patel, M.Sc.
9. Shri K. H. Sawakhande, M.Sc.
10. Smt. Sujata Saxena, M.Sc.
11. Shri N. Thejappa, M.Sc.
12. Smt. J. K. S. Warrier, M.Sc.

Technical Personnel

Technical Officer T-6

Quality Evaluation

1. Shri H. Gangar, B.E. (Electrical), Grad. I.E.T.E.

Quality Evaluation

1. Shri K. S. Bhyrappa, L.T.T., A.T.A.
2. Shri B. S. Ganvir, B.Sc.
3. Kum. I. K. P. Iyer, M.Sc.
4. Shri S. N. Nagwekar, B.Sc.
5. Shri A. W. Shringarpure, B.Sc.

Technical Information

Shri T. K. M. Das, B.Sc., D.B.M., D.E.I.M., Dip. J., D.P.R., Cert. I.S.R.S.

Technical Officer T-5

Photography

Shri R. M. Modi, S.S.C., Cert. Photography

Quality Evaluation

1. Shri K. V. Ananthakrishnan, M.Sc., D.B.M.
2. Shri S. Chandrasekhar, L.T.M., A.T.A., Cert. S.Q.C.
3. Smt. P. A. Dabholkar, B.Sc.
4. Shri H. R. Laxmivenkatesh, D.T.T., A.T.A.
5. Smt. N. D. Nachane, B.Sc.
6. Smt. S. D. Pai, M.Sc.
7. Shri C. R. Sthanu Subramony Iyer, B.Sc.
8. Smt. S. V. Sukhi, M.Sc., D.F.L. (German)
9. Shri V. B. Suryanarayanan, B.Sc.
10. Shri G. Viswanathan, M.Sc., A.T.A.

ANNEXURES

Senior Technical Assistant T-4

1. Shri S. G. Dalvi, S.S.C., Cert. Wireman, Cert. Ref. & A.C., Govt. Elect. Sup.
2. Shri S. M. Gogate, B.Sc.
3. Shri S. J. Guhagarkar, B.Sc.
4. Shri I. H. Hansikatti, B.Sc., A.T.A.
5. Shri H. S. Jayaprakash Narayan, B.Tech (Text.).
6. Smt. S. R. Kamath, B.Sc.
7. Smt. A. A. Kathe, B.Sc.
8. Shri P. K. Mandhyan, B.Sc.
9. Shri E. A. Pachpinde, B.Sc.
10. Shri R. S. Pathare, B.Sc.
11. Shri D. Radhakrishnamurthy, M.Sc., M.Phil.
12. Shri K. B. Rajagopal, B.Sc.
13. Shri S. Sekar, B.Sc.
14. Smt. R. K. Shahani, B.Sc., B.Lib.
15. Shri M. M. Shaikh
16. Shri D. L. Upadhye, S.S.C. (Tech.) N.C.T.V.T., (I.T.I. & C.T.I.)
17. Shri S Vancheswaran, B.Sc.
18. Shri S. Venkatakrishnan, M.Sc.
19. Shri T. Venugopal, B.E. (Civil)
20. Shri G. Vijayan Iyer, Dip. Mech. Engg., Post Dip. Prod. Mgt., A.M.I.E. (Mech.)

Technical Assistant T-II-3

1. Shri Amar Pal, B.Sc.
2. Shri N. O. Anthony
3. Shri U.D. Devikar, B.Sc.
4. Shri P. B. Gurjar
5. Shri Gopal B. Hadge, B.Sc.
6. Shri V. D. Kalsekar, B.Sc.
7. Kum. S. S. Kamerkar, B.Sc., B.Lib.
8. Shri H. S. Koli, B.Sc.
9. Shri M. Mohan, M.Sc.
10. Shri D. N. Moon, B.Sc.
11. Shri V. V. Murudkar, L.T.M.
12. Shri R. D. Nagarkar, B.Sc.
13. Smt. Nirupama Panda, M.Sc.
14. Kum. Y. D. Pai, B.Sc.
15. Shri P. N. Sahane, D.I.F.T.
16. Kum. M. G. Sheela Devi, M.Sc.
17. Kum. M. K. Sugatha Kumari, M.Sc.
18. Shri S. Kumar Subramaniam, B.Sc.
19. Shri M. V. Vivekanandan, B.Sc.
20. Shri S. N. Wani, B.Sc.

Technical Assistant T-I-3

1. Shri R. K. Landge
2. Shri R. B. Pawar

Technical Assistant T-2

1. Smt. K. K. Kale, B.A.
2. Shri S. B. Kambli

Technical Assistant T-1

1. Shri P. G. Kadam
2. Shri D. V. Kambli

Auxiliary Personnel

1. Shri V. V. Kshirsagar*, S.S.C., I.T.C., Cert. Elect. Super., Cert. F. & S., Conditioning Plant Operator T-5.
2. Smt. K. R. Joshi, M.A., Hindi Translator
3. Shri H. B. Tambe*, Plumber T-I-3
4. Shri G. D. Narkar*, Carpenter T-I-3
5. Shri S. S. Patekar*, Driver T-I-3
6. Shri P. J. Ahire*, Operator T-I-3

Operator T-2

1. Shri P. K. Gopalan*
2. Shri Bechan Nokhai*
3. Shri H. K. Pawar*
4. Shri D. B. Gadankush*
5. Shri S. G. Shinde*

Driver

1. Shri B. B. Gaykar*, Driver T-2
2. Shri R. N. Kadam

Operator

1. Shri M. M. Rupawate
2. Shri K. D. Mohite
3. Shri K. K. Kasar
4. Shri S. V. Patil
5. Shri M. B. Thokrul
6. Shri R. G. Chiplunkar
7. Shri T. R. Kadam
8. Shri R. R. Khurdekar
9. Shri G. S. Deorukhkar
10. Shri B. R. Jadhav
11. Shri M. B. Chandanshive
12. Shri V. Y. Unhalekar
13. Shri A. B. Sawant

Administrative Personnel

Administrative Officer

Shri M. K. Jain, B.Sc.

Finance and Accounts Officer

Shri N. S. Sekaran

Assistant Administrative Officer

Shri P. D. Sonawane, B.A.

Superintendent

1. Shri K. Sudhakaran
2. Shri D. P. Naidu
3. Shri G. Moosad, B.Com.

* Holding Technical posts as personal

APPENDICES

Assistant

1. Smt. S. S. Dongre, B.A.
2. Smt. Jayagouri Sivaramakrishnan
3. Shri M. Z. Bhagat
4. Smt. M. V. Kamerkar, B.A.
5. Shri K. W. Khamkar, B.A.
6. Shri S. N. Salve
7. Shri B. D. Sawant
8. Shri A. B. Dalvi
9. Shri D. G. Kulkarni
10. Shri B. S. Bhenwal
11. Smt. S. S. Shanbhag
12. Shri Niraj Kumar Dixit, M.A., Dip. J.
13. Smt. V. V. Desai

Senior Stenographer

Shri Venu Thanikal

Stenographer

1. Smt. S. D. Dudam, M.A.
2. Smt. T. T. Souz

Junior Stenographer

Smt. U. N. Bhandari

Senior Clerk

1. Smt. S. D. Ambre
2. Smt. S. M. Desai
3. Shri A. P. Natu
4. Smt. J. J. Karanjavkar
5. Kum. S. G. Nayar
6. Shri E. T. Gurav

Junior Clerk

1. Shri K. Parleshwar
2. Smt. S. R. Shirsat, B.A.
3. Shri N. V. Kambli
4. Smt. V. V. Janaskar, B.Com.
5. Shri J. R. Mangale
6. Shri S. D. Ambolkar
7. Shri R. K. Pallewad
8. Shri P. V. Jadhav
9. Shri T. S. Patil
10. Kum. S. K. Goankar, B.A.
11. Shri V. S. Sable
12. Smt. J. R. Chavkute
13. Shri P. K. Vasu

Telephone Operator

Kum. S. V. Pai

Supporting Staff Grade III

1. Shri Chatrapal Mhatri
2. Shri G. G. Ambare
3. Shri M. R. Nevrekar

Supporting Staff Grade II

1. Shri T. B. Thapa
2. Shri A. R. Bane
3. Shri T. S. Mhaske
4. Shri S. L. Gawde
5. Shri Shamji Waghela
6. Shri B. K. Sawant
7. Shri N. J. Kharat
8. Shri M. Y. Chandanshive
9. Shri R. B. Jadhav
10. Shri S. M. Sawant
11. Shri M. B. Gurve
12. Shri A. R. Gurjar
13. Shri O. T. Thapa
14. Shri B. R. Satam
15. Shri D. M. Chougule
16. Smt. T. V. Bhowar

Supporting Staff Grade I

1. Shri N. R. Kamble
2. Shri S. D. Gurav
3. Shri M. K. Ghadge
4. Shri M. Z. Rathi
5. Shri Satyanarayan Gope
6. Shri Narayan Singh
7. Shri Mohsin Ahmed
8. Shri C. S. Salvi
9. Shri D. M. Raje
10. Shri D. B. Temgire
11. Shri T. B. Khan
12. Smt. Birmo R. Balmiki
13. Shri C. P. Solanki
14. Shri M. J. Sumra
15. Shri K. T. Mahida
16. Shri R. R. Gosai
17. Shri R. S. Rane
18. Shri H. B. Vaismiya
19. Shri P. G. Ghogale
20. Shri C. V. Shivgan
21. Shri S. S. Angane
22. Shri L. S. Takkar
23. Shri M. M. Katpara
24. Shri G. N. Mayawanshi
25. Shri S. K. Bobate
26. Shri Prakash Patil
27. Shri Ramnivas G. Tak
28. Shri R. P. Karkate
29. Shri S. B. Worlikar
30. Shri N. D. Walzade

APPENDICES

LIST OF STAFF AT THE QUALITY EVALUATION UNITS

1. AKOLA :

Senior Technical Assistant T-4

Shri N. Y. Bansode, B.Sc.

Technical Assistant T-II-3

Shri Adil Zubair, B.Sc.

Supporting Staff Grade I

1. Shri S. R. Patode
2. Shri M. P. Tohokar

2. COIMBATORE :

Technical Officer T-6
(Quality Evaluation)

Shri A. K. Antony, B.Sc.

Technical Officer T-5

(Quality Evaluation)

1. Smt. Santa V. Nayar, B.Sc.
2. Shri C. P. Venugopalan, B.Sc.

Technical Assistant T-II-3

Shri K. Thiagarajan, B.Sc.

Auxiliary Staff
Operator T-2

Shri K. V. Nair

Supporting staff Grade IV

Shri N. Arumugham

Supporting Staff Grade III

Shri V. M. Subramanyan

3. DHARWAD :

Technical Officer T-5

(Quality Evaluation)

Shri E. S. Abraham, B.Sc.

Senior Technical Assistant T-4

Shri M. T. Danolli, B.Sc.

Technical Assistant T-II-3

Shri K. Narayanan, B.Sc.

Supporting Staff Grade III

Shri Y. R. Sone

Supporting Staff Grade I

Shri C. J. Bagalkoti

4. GUNTUR :
Technical Officer T-5
(Quality Evaluation)
Shri R. Dwarakanath, B.Sc.
Senior Technical Assistant T-4
Shri S. Mukundan, B.Sc.
Supporting Staff Grade IV
Shri Ch. Thimmanna
Supporting Staff Grade II
Shri V. Y. M. Survarchala Rao

5. HISSAR :
Senior Technical Assistant T-4
Dr. V. K. Madan, M.Sc., Ph.D.
Technical Assistant T-II-3
Shri Jal Singh, M.Sc.
Supporting Staff Grade IV
Shri Gian Singh
Supporting Staff Grade I
Shri Mahabir Singh

6. INDORE :
Technical Assistant T-II-3
1. Shri S. Banerjee, B.Sc.
2. Shri R. G. Dhakate, B.Sc.
Supporting Staff Grade IV
Shri John Robert
Supporting Staff Grade III
Shri H. S. Bhabar

7. LUDHIANA :
Technical Officer T-7
(Quality Evaluation)
Shri Ram Parkash, B.Sc. L.L.B.
Technical Assistant T-II-3
Shri Hamid Hasan, M.Sc.
Supporting Staff Grade III
Shri Kammikkar Singh

8. NAGPUR :
Scientist (Selection Grade)
Dr. G. R. Anap, M.Tech., Ph.D.
Senior Technical Assistant T-4
Shri V. M. Kulmethe, B.Sc.

Technical Assistant T-II-3

1. Shri S. L. Bhanuse, B.Sc.
2. Shri R. C. Yadav, Dip. Mech. Engg.

Electrician Grade T-1

Shri P. N. Raut

Operator (Auxiliary)

Shri B. V. Shirsath, I.T.I., B.A.

Assistant Administrative Officer

Shri G. Sasidharan, B.A., L.L.B.

Assistant

Shri L. R. Gopalakrishnan

Junior Clerk

1. Shri B. D. Dhengale
2. Smt. G. G. Palorkar, B.A.
3. Shri S. A. Telpande, M.Com.

Driver (Auxiliary)

Shri R. A. Suddawar

Supporting Staff Grade II

Shri B. H. Umredkar

Supporting Staff Grade I

1. Shri H. B. Thapa
2. Shri A. R. Chutale
3. Shri J. P. Patel
4. Shri C. L. Mundale
5. Shri R. B. Kautkar
6. Shri P. S. Panchbudhe
7. Shri I. P. Tomaskar

9. NANDED :

Scientist

Shri L. D. Deshmukh, M.Sc.

Technical Assistant T-II-3

1. Shri R. K. Jadhav, B.Sc.
2. Shri R. S. Prabhudesai, B.Sc.

Supporting Staff Grade III

Shri L. R. Indurkar

Supporting Staff Grade I

Shri S. N. Umare

10. RAHURI :

Senior Technical Assistant T-4
Shri R. S. Darade, B.Sc.

Technical Assistant T-II-3
Shri C. M. More, B.Sc.

Supporting Staff Grade I
Shri D. G. Kamble

11. SIRSA :

Technical Assistant T-II-3
Shri Seeta Ram, M.Sc.

12. SRIGANGANAGAR :

Technical Assistant T-II-3
1. Shri Matish Chandra, M.Sc.
2. Shri Udai Vir Singh, B.Sc., B.Ed.

Supporting Staff Grade IV
Shri Vijendra Singh

Supporting Staff Grade II
Shri Sanwarlal Saini

13. SURAT :

Scientist
Shri Y. Subramanyam, M.Sc.

Technical Officer T-5
(Quality Evaluation)
Shri M. G. Bhalod, B.Sc.

Senior Technical Assistant T-4
Shri G. G. Mistry, B.Sc.

Technical Assistant T-II-3
1. Shri M. B. Patel, B.Sc.
2. Shri V. L. Rangari, B.Sc.

Junior Clerk
Shri J. I. Parmar, B.Com.

Operator (Auxiliary)
Shri J. B. Dhodia

Supporting Staff Grade II
Shri K. M. Rathod

APPENDIX — II

Statement showing the total number of Government servants and the number of Scheduled Casts and Scheduled Tribes amongst them as on March 31, 1990

Group/Class	Permanent / Temporary	Total No. of employees	Scheduled Castes	Percentage to total employees	Scheduled Tribes	Percentage to total employees	Remarks
Gr. A. (Class I)							
Permanent							
(i) Other than lowest rung of Cl. I		28	1	7%	—	—	—
(ii) Lowest rung of Cl. I		21	2				
Total		49	3				
Temporary							
(i) Other than lowest rung of Cl. I		1		25%	—	—	—
(ii) Lowest rung of Cl. I		3	1				
Total		4	1				
Gr. B. (Cl. II)	Permanent	45	5	10%	1	4%	—
	Temporary	4	—		1		
Gr. C. (Cl. III)	Permanent	48	9	26%	—	7%	—
	Temporary	63	20		8		
Gr. D. (Cl. IV) (Excluding Sweepers)	Permanent	42	9	19%	2	6%	—
	Temporary	25	4		2		
Gr. D. (Cl. IV) (Sweepers)	Permanent	1	1	100%	—	—	—
	Temporary	8	8		—		

APPENDIX — III

Statement showing the number of Reserved Vacancies filled by Members of Scheduled Castes and Scheduled Tribes as on 31st March, 1990.

Class of post	Total No. of vacancies		No. of vacancies reserved		Scheduled Castes					Scheduled Tribes				
	Notified	Filled	Out of Col. 2	Out of Col. 3	No. of SCs candidates appointed	No. of SCs vacancies carried forward from the previous year	No. of STs candidates appointed against vacancies reserved for SCs in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for 3 years	No. of vacancies reserved: Out of Col. 2	No. of vacancies reserved: Out of Col. 3	No. of STs candidates appointed	No. of STs vacancies carried forward from the previous year	No. of SCs candidates appointed against vacancies reserved for STs in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for 3 year
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I — Posts filled up by direct recruitment														
Other than lowest rung of Class 1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lowest rung of Class I	1	1	—	—	—	—	—	—	—	—	—	—	—	—
Class II	3	2	2	—	—	1	—	—	1	—	1	—	—	—
Class III	12	12	7	—	3	—	—	—	7	7	4	—	—	—
Class IV (Excluding Sweepers)	10	10	6	—	6	—	—	—	—	—	—	—	—	—
Class IV (Sweepers)	—	—	—	—	—	—	—	—	—	—	—	—	—	—

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
II — Posts filled up by promotions														
Other than Lowest rung of Class I	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lowest rung of Class I	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Class II	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Class III	5	5	—	—	3	—	—	—	—	—	—	—	—	—
Class IV (Excluding Sweepers)	6	6	—	—	1	—	—	—	—	—	—	—	—	—
Class IV (Sweepters)	—	—	—	—	—	—	—	—	—	—	—	—	—	—